UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SHORT-TERM VELOCITY MEASUREMENTS AT COLUMBIA GLACIER, ALASKA: AUGUST - SEPTEMBER 1984

By B. H. Vaughn, C. F. Raymond, L. A. Rasmussen, D. S. Miller, C. A. Michaelson, M. F. Meier, R. M. Krimmel, A. G. Fountain, W. W. Dunlap, and C S. Brown

---

U. S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 85-487

Tacoma, Washington
1985

UNITED STATES DEPARTMENT OF THE INTERIOR

Donald Paul Hodel, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

Project Chief Glaciology
U.S. Geological Survey
1201 Pacific Ave., Suite 450
Tacoma, Washington 98402

Copies of this report can be
purchased from:

Open-File Services Section
Western Distribution Branch
U.S. Geological Survey
Box 25425, Federal Center
Denver, Colorado 80225

CONTENTS

	Page
Abstract	1
Introduction	1
The 1984 velocity measurement field program	5
Data reduction	8
Survey markers	8
EDM measurements	14
Velocity determination	16
References	20
Appendix 1: Sightings of markers from survey stations	21
Appendix 2: Laser-measured distances	26

Illustrations

		Page
Figure 1.	Index map of Columbia Glacier	2
2.	Map showing survey stations and marker positions	4
3.	Diagram showing period of record of sighting and distance measurement	6
4.	Diagram showing horizontal triangulation	11
5.	Graph showing departure of azimuth angles from the long-term trend	15
6.	Graph showing velocity of markers along their trajectories	17
7.	Graph showing velocity of marker number 11 along its trajectory determined by two methods	19

Tables

Table 1.	Survey stations	9
2.	Marker positions and trajectory inclinations	13

Symbols and Abbreviations

Symbol	Name	Units
a	Coefficient in equation of sighting line	dimensionless
b	Coefficient in equation of sighting line	dimensionless
c	Correction factor for both refraction and Earth's curvature	dimensionless
E	Subscript for survey station Easy	--
EDM	Electronic Distance Meter	--
G	Subscript for survey station New Gilbert	--
H	Distance measurement station on Heather Island	--
h	Height of instrument above ground	mm
K_θ	Quality code for estimated error in original theodolite azimuth angle reading	dimensionless
K_ϕ	Quality code for estimated error in original theodolite vertical angle reading	dimensionless
km	Kilometer	--
m	Meter	--
n	Number of distance values	--
p	Atmospheric pressure	mm Hg
Q	Subscript for survey station New Quickie	--
r	EDM distance adjusted for variation in atmospheric density	mm
r	Actual distance measured by EDM at (H)	mm
s	Subscript to represent either G or Q	--
T	Air temperature in degrees Celsius, and also as a subscript denoting target	°C
t	Time in decimal 1984 Julian days	days
u	Velocity component in the x-direction	m/day
UTM	Universal Transverse Mercator	--
v	Velocity comoonent in the y direction	m/day

Symbols and Abbreviations (continued)

x	Horizontal component, positive to the east	m
y	Horizontal component, positive to the north	m
z	Vertical coordinate above mean sea level	m
ε	Error implied by quality codes	grads
θ	Horizontal angle measured to the right of station Easy	grads
λ	Weighting factor for combining estimates of z from two different survey sightings	dimensionless
σ	EDM instrument error	mm
ϕ	Elevation angle below local horizontal	radians

SHORT-TERM VELOCITY MEASUREMENTS AT COLUMBIA GLACIER, ALASKA: AUGUST - SEPTEMBER 1984

by

B. H. Vaughn, C. F. Raymond, L. A. Rasmussen, D. S. Miller, C. A. Michaelson, M. F. Meier, R. M. Krimmel, A. G. Fountain, W. W. Dunlap, and C S. Brown

ABSTRACT

Ice velocity data are presented for the lower reach of Columbia Glacier, Alaska. The data span a 29 day period and contains 1,072 angle sightings from two survey stations to 22 markers placed on the ice surface, and 1,621 laser measurements of the distance to one of those markers (number 11) from another station. These short-interval observations were made to investigate the dynamics of the glacier and to provide input to models for estimation of future retreat and iceberg discharge. The mean ice velocity (at marker number 11) was approximately 9 meters per day and ranged from 8 to >15 meters per day. The data set includes a well defined 2-day 50-percent velocity increase and a clear pattern of velocity fluctuations of about 5 percent with approximately diurnal and semi-diurnal periods.

INTRODUCTION

Columbia Glacier is a large, grounded, iceberg-calving glacier located in south-central Alaska about 38 km (kilometers) west of Valdez (fig. 1). It has an area of approximately 1100 km^2 (square kilometers) and extends 65 km along its main branch to the terminus in Columbia Bay. A short distance in front of the terminus lies a moraine shoal with a maximum depth of about 23 m (meters) below mean sea level. Much of the ice in the lower reach of the glacier lies below sea level. Although the glacier thickness is generally sufficient to overcome the buoyant effect of the water, a notable exception may have occurred briefly during the summer of 1984, when a localized region near the terminus appeared to be floating.

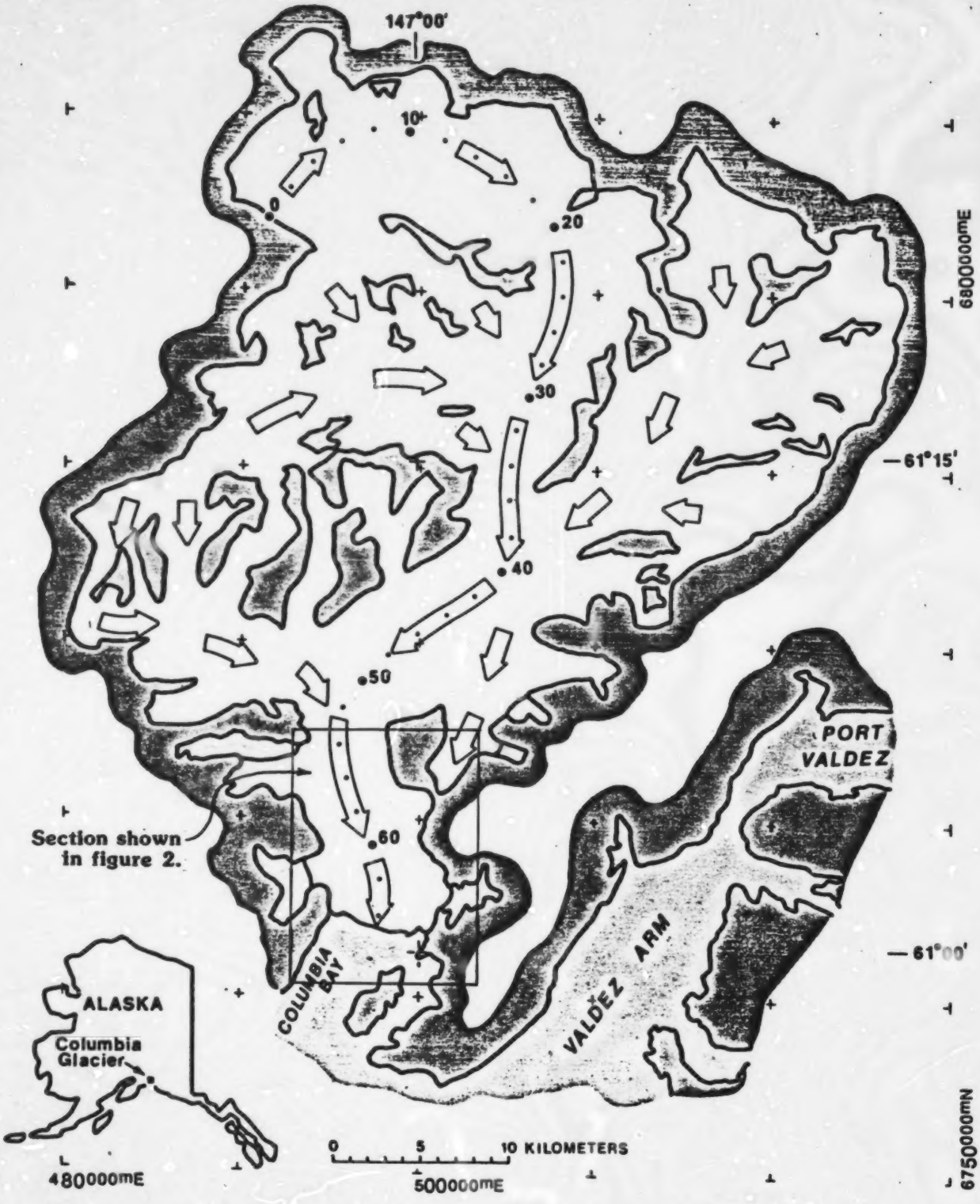

Figure 1.--Index map of Columbia Glacier, Alaska. Arrows show general direction of flow. Main ice stream is indicated by longer arrows and dots at 2-kilometer intervals along the curvilinear, longitudinal coordinate system.

In 1974 Austin Post surmised that an irreversible drastic retreat would ensue should the glacier retreat slightly behind the moraine shoal (Post, 1975). A major research program on Columbia Glacier (Meier and others, 1978) was begun in 1974. Since 1978 the terminus has retreated from the crest of the shoal into water more than 200 m deep. A few kilometers behind the terminus the water is more than 350 m deep.

During the transition from a stable state to one of retreat, knowledge of both the calving flux and the ice velocity is important to understanding the dynamics of the glacier, as well as the continued estimation of iceberg discharge. Two empirical calving relations were developed (Brown and others, 1982; Sikonia, 1982) and then used in numerical models in order to assess the future behavior of Columbia Glacier (Rasmussen and Meier, 1982; Sikonia, 1982; Bindschadler and Rasmussen, 1983). The numerical results indicated that the lower reach would begin disintegrating during the 1980's and that the calving flux would sharply increase. The model results appear to be valid, as the predicted retreat and flux increase (Meier and others, 1980) are occurring. The terminus has retreated about 2 kilometers between 1978 and 1984, and the calving flux approximately tripled between 1978 and late 1984 (Meier and others, 1985). However, the models were very sensitive to the assumed calving relation and therefore may not be applicable in future interpretations.

The terminus configuration and the rate of calving have changed since the early 1980's, which suggests that the calving relations derived empirically from data pertaining to an earlier configuration and mode may no longer be appropriate. The model results are highly sensitive to the calving relation because that relation uses the glacier terminus as a boundary condition. The empirical calving relations were hypothesized first, then calibrated from a data set that included only a few variables, that was relatively sparse in space and time, that was subjected to only preliminary data reduction techniques, and that pertained to

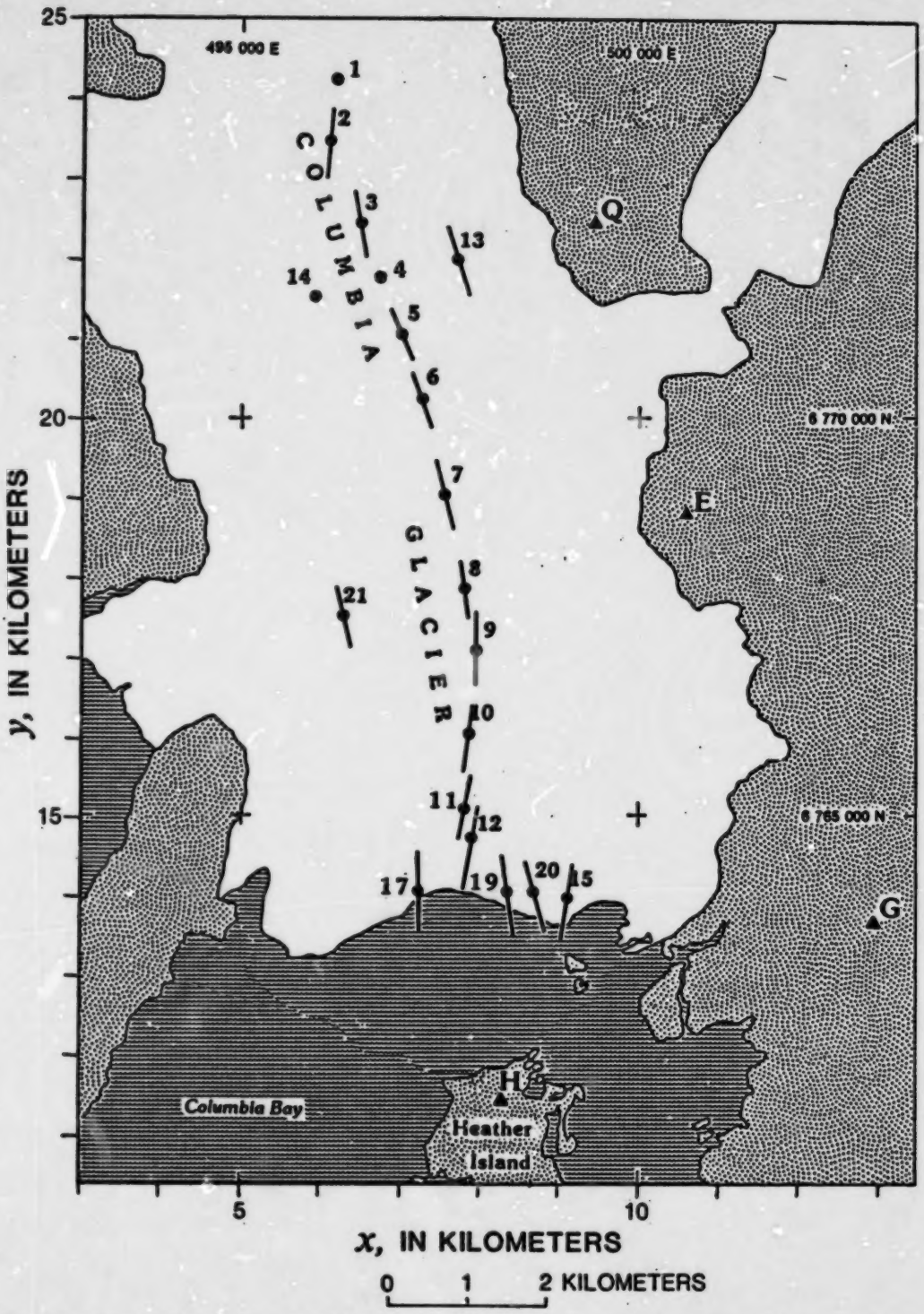

Figure 2.--Survey stations and approximate August 13, 1984 marker positions (dots). Line segments indicate mean direction of flow, and lengths have no significance. Sightings of the markers were made from New Gilbert (G) and New Quickie (Q), using Easy (E) as the azimuth reference, and the distance to marker 11 was measured from the EDM-site (H). The meteorological data used to correct the EDM results were obtained at station (M). The terminus position is that of August 15, 1985.

an earlier configuration of the glacier and mode.

Observations by Austin Post (written communication, 1984) during the summer and fall of 1983 suggested the association of high calving rates with periods of heavy rainfall although this was not true during the 1984 field experiment. Detailed studies of Variegated Glacier (Kamb and others, 1985) indicated that rapid sliding of a glacier during a surge was controlled by water at the bed as were "minisurges" propagating downglacier before and during a surge. Obviously the connection between ice flow, water at the bed, and iceberg calving needs to be investigated.

To that end, an intensive field program in August-September 1984 collected data on calving, ice velocity, terminus position, seismic activity, meltwater production and rainfall, other meteorological variables, tide stage, and runoff from marginal rivers. This data set, when used in conjunction with other data collected systematically but less frequently since about 1977, will be useful in many investigations: those mentioned in this report, others identified but not mentioned, and others that have not been identified yet. The ice-velocity data in this report include both the comprehensive listing of 1,072 survey sightings from two survey stations used to sight 22 markers placed on the ice surface and the comprehensive listing of 1,621 laser measurements of the distance to one of those markers (no. 11) from another station. This report also describes the data-reduction methods and a few preliminary results.

THE 1984 VELOCITY MEASUREMENT FIELD PROGRAM

As a part of the multidisciplinary 1984 field program, the velocity data were obtained in the following manner. Survey stations New Gilbert and New Quickie were occupied 29 and 20 days respectively, beginning August 7 (Julian day 220) during which daily or more frequent sightings of many of the 22 surface marker positions were recorded (fig. 2). The markers were 1-meter tetrahedra constructed from tubular steel covered with fluorescent orange cloth and weighted

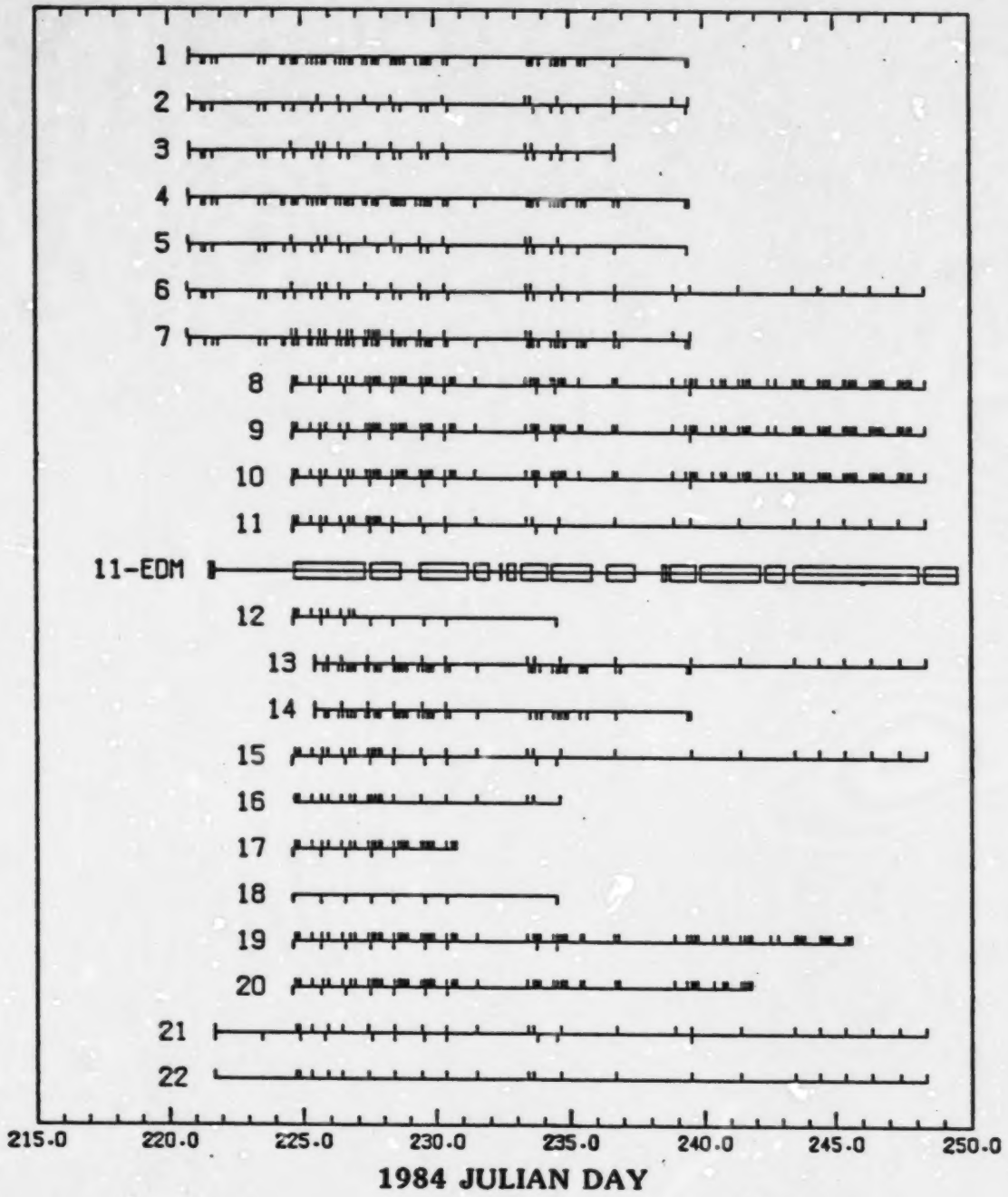

Figure 3.--Period of record of sightings (markers 1-22) and distance measurement (marker 11). For each marker, the upward-pointing tick indicates an azimuth sighting from New Gilbert (G), a downward-pointing tick, one from New Quickie (Q). For marker 11, the rectangles indicate periods during which a distance measurement was made at least every three hours.

with rocks. These were placed by helicopter atop ice pinnacles within predetermined areas on the lower 11 km of the glacier. All markers visible from each station were surveyed once a day, and markers closer to each respective station were surveyed every 3 to 5 hours during daylight hours (fig. 3). Some breaks in the data occurred during periods of fog or heavy rain when the markers could not be seen.

On August 8 distance readings began with a recording electronic distance meter (EDM) located atop a bluff on the north end of Heather Island (fig. 2). The target was a three-prism reflector assembly fixed to two vertical stakes to minimize rotation and wind vibration. The stakes were drilled into the ice about 3.8 km from the EDM, or about 1 km upglacier from the terminus. Readings were taken at 15-minute intervals day and night. In the first several days there were a few short recording gaps during equipment failures. After this shakedown period, the major gaps were caused by fog or heavy rain.

The Hewlett-Packard 3808 EDM[1] uses a gallium arsenide lasing diode with a non-visible beam divergence of 0.0370 grads and a factory rated accuracy of 5mm (millimeter) + 1mm/km, or 9 mm at the beginning target distance of 3.8 km (Adams, 1978). The maximum rated range is 10 km but may require as many as six reflectors. These specifications are accurate during minimal heat shimmer. The details of the data reduction and atmospheric correction are discussed in subsequent sections.

The HP-3808 was operated in a remote function mode, and was triggered electronically by interval timers. Digital output of the metric distance measurements in binary coded decimal was converted by a Wild Heerbrugg interface into signals compatible with an HP-41 series calculator. The data from this interface were automatically transmitted to a HP-41cv calculator, thermal printer, and a digital cassette drive. All systems were operated on external 6 or 12 volt lead-acid

[1] The use of brand names in this report is for identification purposes only and does not imply endorsement by the U.S. Geological Survey.

batteries, which were maintained by a 132 watt array of solar cells fixed to the roof of the instrument shelter. A 3 kilowatt generator was used intermittently during extended periods of foul weather. This system represents a unique field application of data acquisition equipment normally intended for office use.

In operation, the distance reading was automatically stored in the memory of the HP-41 with a time and date, and printed out on thermal paper tape which provided a vital permanent record, immune to power fluctuations and memory loss. The EDM required re-aiming 2 or 3 times a day because the target was not moving directly toward the instrument. Small data gaps appear when this was not done regularly (fig. 3).

Suggested improvements to these instruments include illuminated cross-hairs in the telescope of the instrument for nighttime target viewing with the aid of a flashlight to illuminate the target reflector. This would allow re-aiming during the night as well as switching between multiple targets at any time of day.

DATA REDUCTION

Survey Markers

A local coordinate system with x positive to the east and y positive to the north is related to the Universal Transverse Mercator system according to

$$\begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{0.9996} \begin{pmatrix} E_{UTM} - 490{,}000\ m \\ N_{UTM} - 6{,}750{,}000\ m \end{pmatrix} \qquad (1)$$

and z is the vertical coordinate, positive upward. Time is represented by the Julian day of 1984; it is 214.000 at 0000 hours local time on August 1, 1984 and increases by 1 each day thereafter.

The EDM instrument (H) was on Heather Island and Kern DKM2-AE theodolites were operated at stations New Gilbert (G) and New Quickie (Q), where azimuth angles $\hat{\theta}_G$ and $\hat{\theta}_Q$ to the markers were measured in grads to the right of station Easy (E). These stations are shown in figure 2 and their coordinates are given in

Table 1.--Survey stations.

[Coordinates x, y, z are in local coordinate system (equation 1) in meters].

Station	x	y	z
Easy (E)	10,543.3	18,808.9	461.1
New Gilbert (G)	12,923.2	13,643.6	448.4
New Quickie (Q)	9,441.6	22,464.6	701.8
EDM-site (H)	8,272.3	11,373.6	26

table 1. These letters will be used as subscripts as well as subscript T meaning Target.

The original angles $\hat{\theta}_G$ and $\hat{\theta}_Q$ are transformed to radians measured in the mathematically positive direction from the positive x-axis according to

$$\begin{pmatrix} \theta_G \\ \theta_Q \end{pmatrix} = \begin{pmatrix} 8.285744 \\ 5.005084 \end{pmatrix} - \frac{\pi}{200} \begin{pmatrix} \hat{\theta}_G \\ \hat{\theta}_Q \end{pmatrix} \tag{2}$$

in which the constants are related to the azimuths to station Easy from stations New Gilbert and New Quickie.

Neglecting the effect of Earth's curvature in determining horizontal coordinates, the equations of the two sighting lines are:

$$y = \begin{pmatrix} a_G \\ a_Q \end{pmatrix} x + \begin{pmatrix} b_G \\ b_Q \end{pmatrix} \tag{3}$$

Letting s represent either G or Q, the slope in the x,y plane is $a_S = \tan \theta_S$ and the intercept is $b_S = y_S - a_S x_S$ (fig. 4). The coordinates of their intersection are

$$\begin{pmatrix} x_T \\ y_T \end{pmatrix} = \frac{1}{a_Q - a_G} \begin{pmatrix} b_G - b_Q \\ a_Q b_G - a_G b_Q \end{pmatrix} \tag{4}$$

in which the subscript T denotes the survey target.

Taking into account the effects of both refraction and Earth's curvature, by means of the factor (Bouchard and Moffitt, 1972) $c \approx 6.8 \times 10^{-8}$ for distances in meters, the vertical coordinate of the marker is given by

$$z_T(s) = z_S + h_S + (cr_S - \tan \phi_S)\, r_S \tag{5}$$

in which h_S is the height of the instrument above the ground, Z_S is altitude of station, ϕ_S is the elevation angle in radians as measured below the local horizontal, and $r_S = [(x_S - x_T)^2 + (y_S - y_T)^2]^{1/2}$. As the vertical coordinate can be estimated from either station independently from observations at the other station, a linear combination of the two estimates may be used for the altitude of the marker.

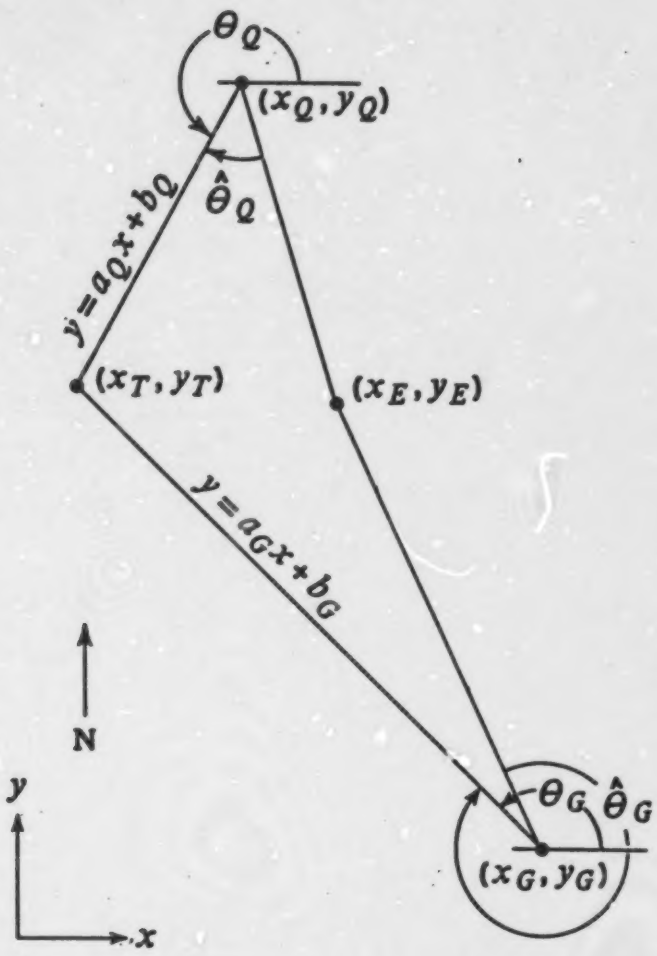

Figure 4.--Horizontal triangulation from survey stations New Gilbert (G) and New Quickie (Q), using Easy (E) as the reference.

$$z_T = \lambda z(G) + (1-\lambda)z(Q) \qquad (6)$$

Determining the optimum value of λ (L. A. Rasmussen, U.S. Geological Survey, written communication, 1985) is beyond the scope of this report.

Because sightings of the moving markers were not made simultaneously from the two survey stations, time interpolation in the angle data--from one, or the other, or sometimes both stations--was used to get synchronous values for use in equations 2-6. The period of record of observation of each of the markers is shown in figure 3. Marker trajectories over this short period of record are very nearly straight lines; trajectory directions and representative marker positions are given in table 2.

Quality codes--based on comparison of forward and reverse sightings and, for the azimuth angles, on the apparent change of azimuth to the reference station Easy between the beginning and the end of a set of sightings--were assigned to each of the measured angles, indicating the probable error: 0 for 0.0030 grads, 1 for 0.0060, 2 for 0.0090, and 3 for 0.0120. Reference elevation angles to a fixed, known point were not regularly made, as a check on atmospheric refraction; therefore, this report does not include c-values for use in equation 5. The individual angles, along with the times of the sightings and the quality codes, are given in Appendix 1.

Each of two points (x_1, y_1) and (x_2, y_2) on a marker's trajectory--which is taken to be a straight line--is determined by applying equation 4 to a pair of azimuth angles, one from each of the two survey stations, generally with the use of some time interpolation to make them synchronous. The position of the marker corresponding to azimuth θ_S from survey station (x_S, y_S) is

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} x_S \\ y_S \end{pmatrix} + \frac{a}{b} \begin{pmatrix} 1 \\ \tan \theta_S \end{pmatrix} \qquad (7)$$

in which $a = (x_1 - x_S)\,\Delta y - (y_1 - y_S)\,\Delta x$ and $b = \Delta y - \Delta x \tan \theta_S$, with $\Delta x = x_2 - x_1$ and $\Delta y = y_2 - y_1$. Given the time rate of change $\dot{\theta}_S$ of the azimuth angle as

Table 2.--Marker positions and trajectory inclinations. The positions are for t = 226.000 (0000 hours local time on August 13, 1984), except that t = 220.837 for no. 1 and t = 220.806 for no. 4. [Coordinates x, y, z are in local coordinate system (equation 1) in meters].

Marker	x	y	$\Delta\xi/\Delta\psi$
1	6147	24274	
2	6118	23497	0.085
3	6482	22464	-0.193
4	6723	21721	
5	6982	21066	-0.428
6	7244	20239	-0.375
7	7514	19044	-0.242
8	7761	17867	-0.131
9	7885	17059	0.003
10	7805	16027	0.135
11	7739	15112	0.175
12	7819	14734	0.169
13	7692	21998	-0.316
14	5922	21530	-0.450
15	9049	13962	
17	7173	14058	0.022
19	8263	14039	0.162
20	8608	14052	0.286
21	6256	17509	-0.231

well, the velocity of the marker along the trajectory is

$$\begin{pmatrix} u \\ v \end{pmatrix} = \frac{(1 + \tan^2\theta_s)\, a\, \dot{\theta}_s}{b^2} \begin{pmatrix} \Delta x \\ \Delta y \end{pmatrix} \qquad (8)$$

in which u is the component in the x-direction, and v is the component in the y-direction.

EDM Measurements

The EDM readings were recorded digitally at approximately 15-minute intervals except during periods of equipment failure or impaired visibility (fig. 3). They were adjusted for variations of atmospheric density (Adams, 1978) where the adjusted value r is given by

$$r = \left(279.42 - \frac{105.885\, p}{273.2 + \overline{T}}\right) \times 10^{-6}\ \hat{r} \qquad (9)$$

in which p is the pressure in mm of mercury, $\overline{T}$ is the air temperature in degrees Celsius, and r is the original distance reading. The values of $\hat{t}$, r, and $\hat{r}$ are given in Appendix 2. The adjustment was small ($-41 \leq r - \hat{r} \leq 1$ mm) especially compared with the average daily change in r, which was about 9 m. The p and $\overline{T}$ data were taken at a site approximately 300 m to the northwest of the EDM instrument site at an altitude of 15 m above sea level and 1 m above the ground (Fig. 2).

Given two points (x_1, y_1) and (x_2, y_2) on the trajectory of the EDM-reflector (marker 11)--which is assumed to be a straight line--and given the distance r from the EDM-instrument at (x_H, y_H), the point on the trajectory is given by

$$y = y_H + (mF + \sqrt{Mr^2 - F^2}\,)/M \qquad (10)$$

$$x = my - f$$

in which $M = m^2 + 1$ and $F = f + x_H - my_H$, with $m = (x_2 - x_1) / (y_2 - y_1)$ and $f = (x_2y_1 - x_1y_2) / (y_2 - y_1)$. Given the time rate of change $\dot{r}$ of the distance as well, the velocity of the reflector is given by

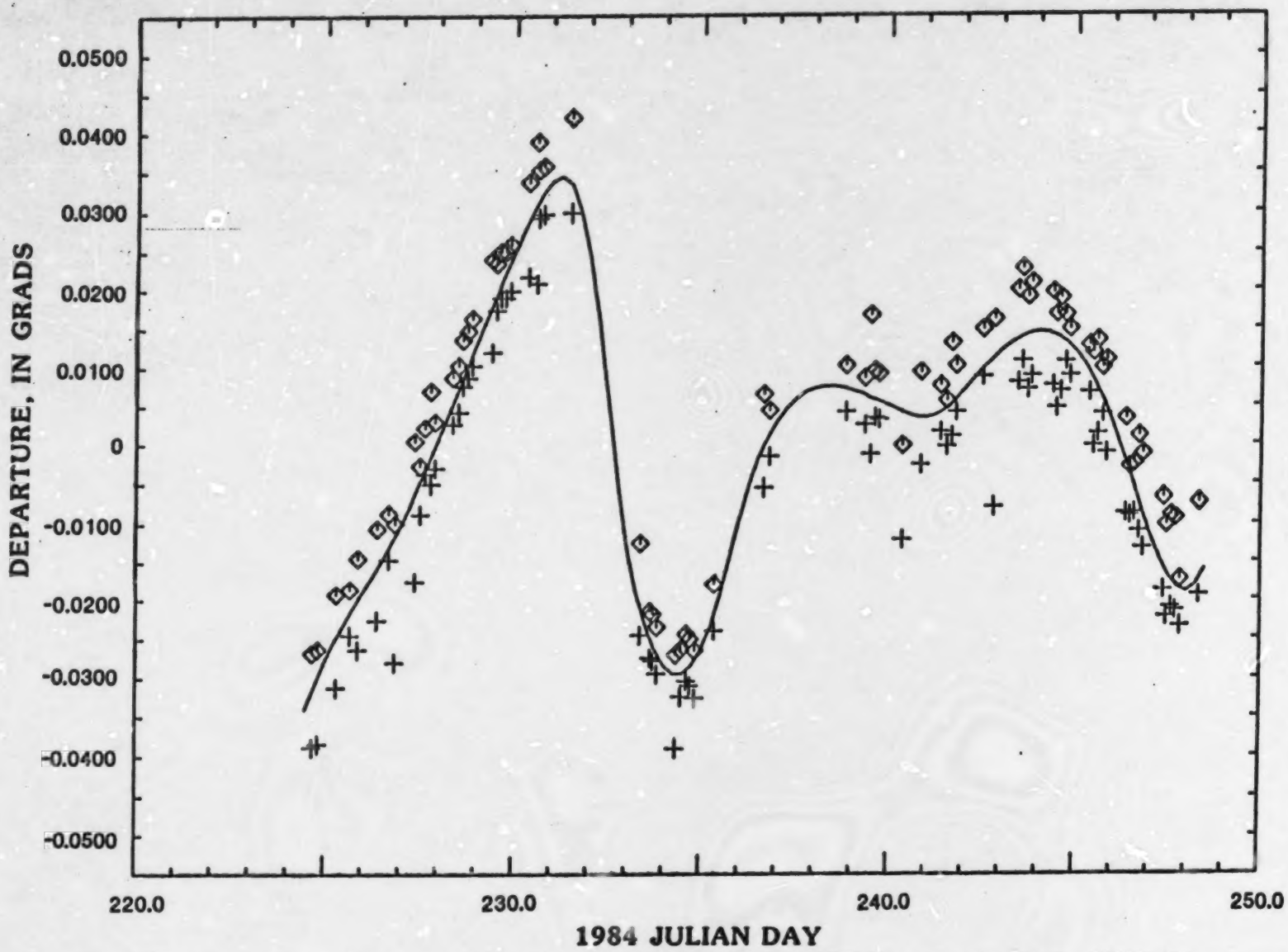

Figure 5.--Departure of azimuth angles from the long-term trend, for marker 10 as surveyed from New Gilbert (G). The ordinates $\Delta\theta + \varepsilon$ (squares) and $\Delta\theta - \varepsilon$ (crosses) are taken to be the error bar for each sighting, where $\Delta\theta$ is the departure and ε is the error associated with the sighting. Shown also is a smooth curve fit by hand to the error bars.

$$\begin{pmatrix} u \\ v \end{pmatrix} = \frac{r\dot{r}}{\sqrt{Mr^2 - F^2}} \begin{pmatrix} m \\ 1 \end{pmatrix} \qquad (11)$$

The foregoing involves, essentially, the intersection of a circle with a straight line, the general solution for which has been particularized here--with respect to the sign taken with the radical and the expression of the slope--for the trajectory-instrument configuration at Columbia Glacier.

VELOCITY DETERMINATION

When azimuth angles to a marker were available from both survey stations, they were used (equations 3,4) to establish the marker's x, y trajectory, which was approximated by a straight line (table 2). The azimuth angles θ from the station with the more numerous sightings of a marker were then used (equation 8) to estimate the velocity along the trajectory. To get the derivative $\dot{\theta}$ and to get velocity as a function of time, it is necessary to have θ as a function of time.

A single least-squares cubic polynomial P(t) was used to represent the long-term (period of record) trend of the θ vs t data, and the departures $\Delta\theta$ from the cubic of the individual θ-values were then considered as a function of t. Where ε is the error implied by the quality codes assigned to the individual sightings, an error bar was formed by plotting (fig. 5) $\Delta\theta + \varepsilon$ and $\Delta\theta - \varepsilon$ at the t-coordinate of each θ-value. A smooth curve f(t) was fit by hand to the error bars, $\theta(t) = P(t) + f(t)$ and $\dot{\theta}(t) = \dot{P}(t) + \dot{f}(t)$ being used to estimate the quantities in equation 8. The two velocity components are combined to give the total speed $\sqrt{u^2 + v^2}$ along the trajectory as a function of t in figure 6.

A cubic spline (Reinsch, 1967) was used to smooth the n = 1,621 distance values r_i obtained from the EDM. The spline g(t) consists of a separate cubic polynomial on each interval (t_i, t_{i+1}), has continuity of function value and first two derivatives, and minimizes

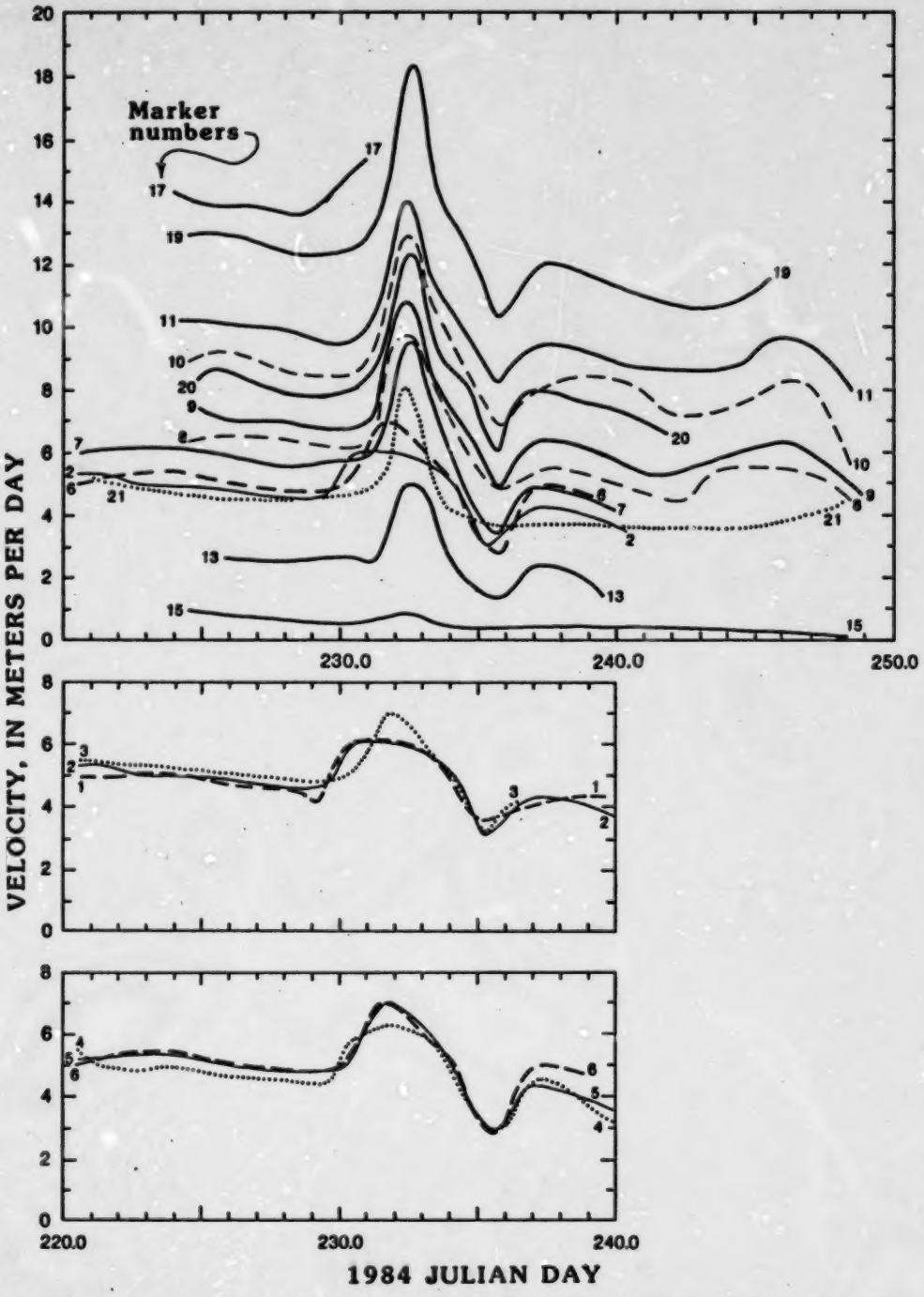

Figure 6.--Velocity of markers along their trajectories. Markers 1 through 3 and 4 through 6 are shown separately for clarity. Omitted from this analysis were marker 12, for which frequent sightings were lacking from both survey stations; marker 14, which apparently fell from the serac on which it was placed; and markers 16, 18, and 22, which were each sighted from only one survey station.

$$I = \int_{t_1}^{t_n} [\ddot{g}(t)]^2 \, dt \tag{12}$$

subject to

$$\frac{1}{n} \sum_{i=1}^{n} [g(t_i) - r_i]^2 \leq \sigma^2 \tag{13}$$

Where σ = 10 mm includes the standard error of the instrument--5 mm plus 1 mm for each km of distance (Adams, 1978), and 1 mm error due to recording the time to the nearest minute.

The function value of the spline and its first derivative $\dot{g}(t)$ are used as estimates of the quantities r and $\dot{r}$ in equations 10 and 11. The two velocity components are combined to give the total speed along the trajectory as a function of t in figure 7, which also shows the curve for marker 11 determined from the Survey sightings (fig. 6). The agreement between the two curves is good except near the ends of the interval because the interpolation of $\Delta\theta$ (fig. 5) is less reliable at the ends.

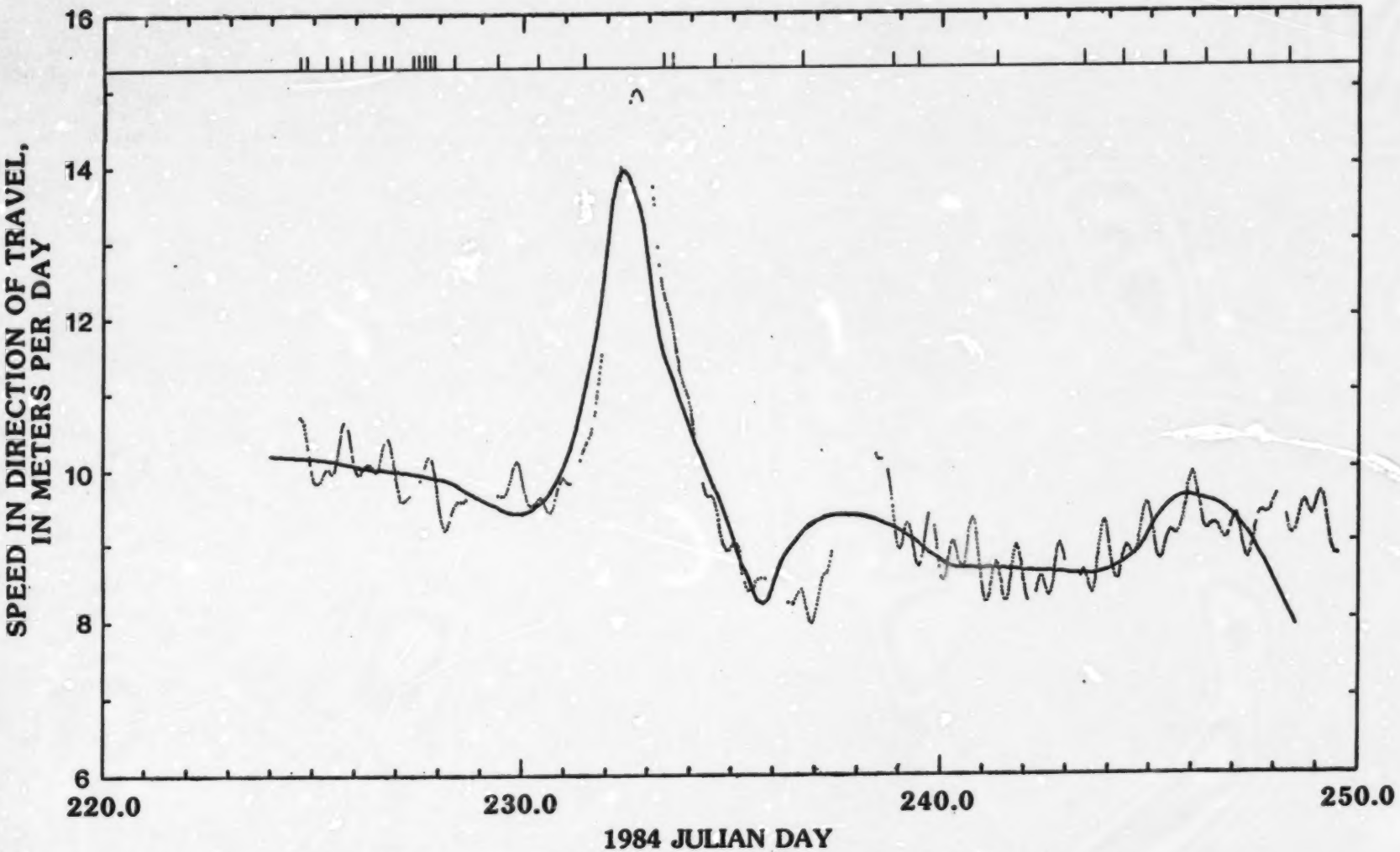

Figure 7.--Velocity of marker 11 along its trajectory determined by two methods. The velocity (solid) determined by equation 8 from azimuth angles sighted at New Gilbert is shown for comparison with the velocity (dotted) determined by equation 11 from the distance measurements made at the EDM-site. Rake scale at top shows period of record for survey sightings to the marker (fig. 3).

REFERENCES

Adams, Kenneth, 1978, Hewlett-Packard model 3808A Medium Range Distance Meter Operating Manual: Loveland Colorado, Hewlett-Packard Instrument Division, 53 p.

Bindschadler, R. A., and Rasmussen, L. A., 1983, Finite difference model predictions of the drastic retreat of Columbia Glacier, Alaska: U.S. Geological Survey Professional Paper 1258-D, 17 p.

Bouchard, Harry, revised by Frances H. Moffitt, 1972, Surveying (fifth edition): Scranton, PA, The Haddon Craftsmen, Inc., 754 p.

Brown, C. S., Meier, M. F., and Post, Austin, 1982, Calving speed of Alaska tidewater glaciers, with application to Columbia Glacier: U.S. Geological Survey Professional Paper 1258-C, 13 p.

Kamb, Barclay, Raymond, C. F., Harrison, W. D., Engelhardt, Hermann, Echelmeyer, K. A., Humphrey, N., Brugman, M. M., Pfeffer, T., 1985, Glacier surge mechanism: 1982-1983 surge on variegated glacier, Alaska: Science, v. 227, no. 4686, p. 469-479.

Meier, M. F., Post, Austin, Brown, C. S., Frank, David, Hodge, S. M., Mayo, L. R., Rasmussen, L. A., Senear, E. A., Sikonia, W. G., Trabant, D. C., and Watts, R. D., 1978, Columbia Glacier progress report--December 1977, U.S. Geological Survey Open-File Report 78-264, 78 p.

Meier, M. F., Rasmussen, L. A., and Miller, D. S., 1985, Columbia Glacier in 1984: disintegration underway: U.S. Geological Survey Open-File Report 85-81, 21 p.

Meier, M. F., Rasmussen, L. A., Post, Austin, Brown, C. S., Sikonia, W. G., Bindschadler, R. A., Mayo, L. R., and Trabant, D. C., 1980, Predicted timing of the disintegration of the lower reach of Columbia Glacier, Alaska: U.S. Geological Survey Open-File Report 80-582, 47 p.

Post, Austin, 1975, Preliminary hydrography and historic terminal changes of Columbia Glacier, Alaska: U.S. Geological Survey Hydrologic Investigations Atlas, 3 sheets.

Rasmussen, L. A., and Meier, M. F., 1982, Continuity equation model of the predicted drastic retreat of Columbia Glacier, Alaska: U.S. Geological Survey Professional Paper 1258-A, 23 p.

Reinsch, C. H., 1967, Smoothing by spline functions: Numerische Mathematik, no. 10, pp. 177-183.

Sikonia, W. G., 1982, Finite element glacier dynamics model applied to Columbia Glacier, Alaska: U.S. Geological Survey Professional Paper 1258-B, 74 p.

Appendix 1. Sightings of markers from survey stations.

The time shown $\hat{t}$ is 200 less than the 1984 Julian Day, which is 214.000 at 0000 hours on August 1, 1984 and increases by 1 each day thereafter. The azimuth angle $\hat{\theta}$ is measured in grads to the right of Easy (fig. 2, equation 2). The elevation angle ϕ is measured in grads below the horizontal. The quality codes K_θ and K_ϕ following the values for the angles indicate the estimated error: 0 for 0.0030 grads, 1 for 0.0060, 2 for 0.0090, and 3 for 0.0120. The instrument height h is in mm above the altitude of the survey station.

Apparently incorrect values from New Gilbert for θ are marker #3 at t = 27.367, #6 at 27.374, #7 at 26.674, #10 at 40.702, #19 at 26.872 and 27.901, #20 at 27.756, and for ϕ are #2 at 20.833 and 28.372, #3 at 20.826, #6 at 25.910, #7 at 20.744 and 28.376, #8 at 25.884, #14 at 28.385, #15 at 27.398, #16 at 28.374; those from New Quickie for θ are #1 at 28.872, #4 at 28.876, #7 at 28.880, #11 at 27.520, #12 at 29.547, #13 at 28.875, #14 at 28.874, #15 at 29.556 and for ϕ are #12 at 26.531, #15 at 26.521.

$\hat{t}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 1 FROM NEW GILBERT					
20.837	391.3584	2			1670
MARKER 1 FROM NEW QUICKIE					
20.837	150.6091	1	5.6554	1	1466
21.311	150.5693	0	5.6572	0	1466
21.432	150.5613	0	5.6589	0	1466
21.720	150.5360	0	5.6604	0	1466
21.874	150.5254	0	5.6611	0	1466
23.476	150.4031	0	5.6694	0	1466
23.681	150.3862	0	5.6702	0	1466
24.308	150.3374	0	5.6729	0	1466
24.410	150.3282	0	5.6737	0	1466
24.675	150.3060	0	5.6764	0	1466
24.776	150.2992	0	5.6764	0	1466
24.890	150.2900	0	5.6765	0	1466
25.264	150.2652	0	5.6789	0	1466
25.447	150.2497	0	5.6797	0	1466
25.609	150.2383	0	5.6828	0	1466
25.794	150.2253	0	5.6825	0	1466
25.907	150.2158	0	5.6828	0	1466
26.299	150.1857	0	5.6841	0	1466
26.451	150.1753	0	5.6855	0	1466
26.596	150.1646	0	5.6865	1	1466
26.767	150.1530	0	5.6898	0	1466
26.899	150.1426	0	5.6863	0	1466
27.302	150.1109	0	5.6895	0	1510
27.445	150.1020	0	5.6903	0	1510
27.651	150.0908	0	5.6934	0	1510
27.771	150.0820	2	5.6929	2	1510
27.887	150.0811	2	5.6921	2	1510
28.396	150.0320	0	5.6956	0	1553
28.480	150.0310	0	5.6976	0	1553
28.594	150.0215	0	5.6966	0	1553
28.742	150.0094	0	5.6982	0	1553
28.872	150.0244	1	5.6985	0	1553
29.326	149.9735	0	5.6996	0	1560
29.512	149.9534	0	5.7010	0	1560
29.634	149.9463	1	5.7016	0	1560
29.772	149.9409	0	5.7024	0	1560
29.877	149.9285	0	5.7028	0	1560
30.368	149.8892	0	5.7046	0	1560
30.528	149.8659	0	5.7066	0	1560
31.549	149.8068	0	5.7098	1	1560
33.481	149.5971	0	5.7166	0	1560
33.590	149.5869	0	5.7186	0	1560
33.681	149.5807	0	5.7170	0	1560
33.886	149.5578	0	5.7186	0	1560

$\hat{t}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 1 FROM NEW QUICKIE (cont.)					
34.351	149.5262	0	5.7224	0	1560
34.507	149.5124	0	5.7233	0	1560
34.627	149.5074	0	5.7248	0	1560
34.771	149.4960	0	5.7242	0	1560
34.876	149.4915	0	5.7251	0	1560
35.348	149.4684	0	5.7296	1	1560
35.483	149.4550	1	5.7290	1	1560
35.624	149.4468	1	5.7279	0	1560
36.715	149.3850	0	5.7344	0	1560
39.367	149.2102	0	5.7417	0	1560
39.474	149.2053	1	5.7416	0	1560
MARKER 2 FROM NEW GILBERT					
20.833	389.1001	2	.5111	2	1670
25.644	389.0136	0	.5228	0	1520
26.365	389.0017	1	.5180	0	1650
27.365	388.9819	2	.5186	0	1650
28.372	388.9690	0	.4759	0	1760
30.353	388.9391	1	.5311	0	1760
33.402	388.8767	1	.5334	0	1760
33.574	388.8713	0	.5339	0	1500
34.589	388.8550	0	.5354	0	1500
36.689	388.8279	2	.5388	1	1450
38.863	388.7985	2	.5387	2	1310
39.481	388.7938	2	.5459	2	1310
MARKER 2 FROM NEW QUICKIE					
20.836	138.2713	1	6.2048	1	1466
21.308	138.2278	0	6.2080	0	1466
21.429	138.2176	0	6.2093	0	1466
21.717	138.1885	0	6.2121	0	1466
23.474	138.0305	0	6.2234	0	1466
23.683	138.0108	0	6.2248	0	1466
24.408	137.9466	0	6.2296	0	1466
24.774	137.9128	0	6.2321	0	1466
25.445	137.8548	0	6.2378	0	1466
25.791	137.8254	0	6.2399	0	1466
26.451	137.7679	0	6.2458	0	1466
26.766	137.7414	0	6.2475	0	1466
27.883	137.6389	2	6.2570	2	1510
28.477	137.5999	0	6.2608	0	1553
28.740	137.5756	0	6.2620	0	1553
29.510	137.5104	0	6.2657	0	1560
29.770	137.4946	1	6.2681	0	1560
30.526	137.4110	1	6.2744	0	1560
33.702	137.0609	0	6.2938	0	1560

$\hat{t}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 2 FROM NEW QUICKIE (cont.)					
34.365	137.0201	0	6.2990	0	1560
34.758	136.9888	0	6.3008	0	1560
35.359	136.9560	1	6.3045	0	1560
36.728	136.8627	1	6.3150	0	1560
39.381	136.6557	0	6.3289	0	1560
MARKER 3 FROM NEW GILBERT					
20.826	387.4043	2	1.0084	2	1670
24.644	387.3481	0	.9315	0	1520
25.649	387.3387	0	.9379	0	1520
25.878	387.3355	1	.9350	0	1650
26.369	387.3293	1	.9380	0	1650
27.367	387.2653	2	.9407	0	1650
28.362	387.3037	0	.9497	0	1760
29.440	387.2913	1	.9568	1	1760
30.358	387.2828	1	.9600	0	1760
33.401	387.2359	1	.9751	0	1760
33.644	387.2347	0	.9778	0	1500
34.592	387.2213	0	.9837	0	1500
36.693	387.2022	1	.9921	1	1450
MARKER 3 FROM NEW QUICKIE					
20.835	119.1972	1	8.5762	1	1466
21.306	119.1431	0	8.5860	0	1466
21.426	119.1300	0	8.5904	0	1466
21.715	119.0945	0	8.5973	1	1466
23.471	118.9002	0	8.6341	0	1466
23.685	118.8764	0	8.6394	0	1466
24.406	118.7976	0	8.6534	0	1466
24.771	118.7572	0	8.6619	0	1466
25.442	118.6868	0	8.6772	0	1466
25.788	118.6492	0	8.6837	0	1466
26.447	118.5797	0	8.6980	0	1466
26.765	118.5457	0	8.7026	0	1466
27.878	118.4234	2	8.7266	2	1510
28.474	118.3730	0	8.7403	0	1553
28.738	118.3434	1	8.7436	0	1553
29.508	118.2618	0	8.7588	0	1560
29.759	118.2407	0	8.7630	0	1560
30.505	118.1638	0	8.7773	0	1560
33.465	117.7742	0	8.8340	0	1560
33.708	117.7484	1	8.8435	0	1560
34.362	117.6764	0	8.8571	0	1560
34.756	117.6396	0	8.8672	0	1560
35.357	117.6002	1	8.8816	0	1560
36.725	117.4864	0	8.9046	1	1560

$\hat{t}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 4 FROM NEW GILBERT					
20.806	385.8115	2	1.3526	2	1670
MARKER 4 FROM NEW QUICKIE					
20.833	101.6321	1	10.3962	1	1466
21.303	101.5783	0	10.3965	0	1466
21.424	101.5644	0	10.3991	0	1466
21.712	101.5304	0	10.3985	0	1466
21.872	101.5124	0	10.3996	0	1466
23.469	101.3393	0	10.4053	0	1466
23.688	101.3145	0	10.4059	0	1466
24.306	101.2466	0	10.4077	0	1466
24.401	101.2350	0	10.4074	0	1466
24.673	101.2028	0	10.4089	0	1466
24.768	101.1946	0	10.4087	0	1466
24.887	101.1796	0	10.4093	0	1466
25.261	101.1432	0	10.4095	0	1466
25.435	101.1254	0	10.4113	0	1466
25.608	101.1046	0	10.4110	1	1466
25.776	101.0864	1	10.4129	0	1466
25.905	101.0734	0	10.4134	0	1466
26.292	101.0338	0	10.4135	0	1466
26.437	101.0165	0	10.4133	0	1466
26.593	100.9991	0	10.4163	0	1466
26.738	100.9846	1	10.4153	0	1466
26.751	100.9875	0	10.4152	0	1466
26.896	100.9682	0	10.4143	0	1466
27.293	100.9273	0	10.4178	0	1510
27.438	100.9132	0	10.4184	0	1510
27.641	100.8933	0	10.4185	0	1510
27.762	100.8904	2	10.4221	2	1510
27.867	100.8701	2	10.4191	2	1510
28.390	100.8167	0	10.4219	0	1553
28.462	100.8084	0	10.4237	0	1553
28.525	100.7974	0	10.4233	0	1553
28.732	100.7837	1	10.4241	1	1553
28.876	100.7933	0	10.4226	0	1553
29.319	100.7264	1	10.4253	0	1560
29.500	100.7028	0	10.4266	0	1560
29.628	100.6900	1	10.4265	0	1560
29.763	100.6797	1	10.4267	0	1560
29.871	100.6656	1	10.4275	0	1560
30.363	100.6100	0	10.4277	0	1560
30.521	100.5853	0	10.4274	0	1560
31.547	100.4934	1	10.4270	1	1560
33.471	100.1867	0	10.4208	0	1560
33.573	100.1680	0	10.4229	1	1560
33.668	100.1618	0	10.4231	0	1560
33.876	100.1306	0	10.4233	0	1560
34.344	100.0841	0	10.4242	1	1560
34.500	100.0689	0	10.4273	0	1560
34.619	100.0622	0	10.4265	0	1560
34.765	100.0490	0	10.4292	0	1560
34.871	100.0408	1	10.4288	0	1560
35.340	100.0049	1	10.4299	0	1560
35.476	99.9944	1	10.4307	0	1560
35.617	99.9819	0	10.4307	0	1560
36.707	99.9051	0	10.4359	0	1560
36.868	99.8869	0	10.4357	0	1560
39.358	99.6541	0	10.4450	1	1560
39.468	99.6462	0	10.4498	0	1560
MARKER 5 FROM NEW GILBERT					
20.760	384.5623	2	1.4768	2	1670
24.646	384.5239	0	1.4840	0	1520
25.655	384.5212	0	1.4856	0	1520
25.908	384.5155	1	1.4795	0	1650
26.373	384.5140	1	1.4847	0	1650
27.371	384.4993	2	1.4849	0	1650
28.364	384.4923	0	1.4910	0	1760
29.438	384.4836	1	1.4951		1760
30.356	384.4784	1	1.4983	0	1760
33.398	384.4405	1	1.5046	0	1760
33.582	384.4376	1	1.5037	1	1500
34.596	384.4311	0	1.5061	0	1500
MARKER 5 FROM NEW QUICKIE					
20.831	86.3181	1	10.4410	1	1466
21.295	86.2614	0	10.4419	0	1466
21.419	86.2488	0	10.4434	0	1466
21.708	86.2127	0	10.4448	0	1466
23.465	86.0070	0	10.4495	0	1466
23.703	85.9780	0	10.4502	0	1466
24.399	85.8978	0	10.4529	0	1466

$\hat{t}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 5 FROM NEW QUICKIE (cont.)					
24.763	85.8550	0	10.4540	0	1466
25.401	85.7825	0	10.4575	0	1466
25.769	85.7414	0	10.4590	0	1466
26.435	85.6675	1	10.4608	0	1466
26.733	85.6344	0	10.4617	0	1466
27.865	85.5115	2	10.4653	2	1510
28.459	85.4478	0	10.4691	0	1553
28.726	85.4212	0	10.4688	0	1553
29.495	85.3374	0	10.4722	0	1560
29.757	85.3116	1	10.4717	0	1560
30.503	85.2295	0	10.4752	0	1560
33.463	84.8054	0	10.4777	0	1560
33.689	84.7773	0	10.4803	0	1560
34.360	84.6998	0	10.4795	0	1560
34.753	84.6632	0	10.4837	0	1560
35.354	84.6210	0	10.4815	1	1560
36.723	84.5186	1	10.4852	0	1560
39.374	84.2763	0	10.4913	0	1560
MARKER 6 FROM NEW GILBERT					
20.750	382.2991	2	1.7760	2	1670
24.649	382.2474	0	1.7880	0	1520
25.660	382.2363	0	1.7917	0	1520
25.910	382.2353	1	1.7860	0	1650
26.374	382.2267	1	1.7918	0	1650
27.374	382.1994	2	1.7914	0	1650
28.365	382.1991	0	1.7949	0	1760
29.436	382.1871	1	1.7988	0	1760
30.360	382.1780	1	1.8013	0	1760
33.396	382.1258	1	1.8031	0	1760
33.584	382.1219	0	1.8046	0	1500
34.599	382.1093	0	1.8085	0	1500
36.735	382.0889	1	1.8153	0	1450
38.872	382.0660	2	1.8169	1	1310
39.483	382.0586	1	1.8204	1	1310
41.372	382.0456	0	1.8277	0	1750
43.447	382.0312	1	1.8361	0	1560
44.385	382.0203	1	1.8379	0	1620
45.356	382.0105	0	1.8369	0	1620
46.350	382.0008	1	1.8397	0	1620
47.381	381.9898	1	1.8425	0	1620
48.341	381.9828	1	1.8423	0	1620
MARKER 6 FROM NEW QUICKIE					
20.829	68.7559	1	9.9711	1	1466
21.293	68.7085	0	9.9711	0	1466
21.416	68.6976	0	9.9711	0	1466
21.706	68.6668	0	9.9699	0	1466
23.462	68.4951	0	9.9648	0	1466
23.701	68.4682	0	9.9643	0	1466
24.397	68.3999	0	9.9637	0	1466
24.760	68.3627	0	9.9633	0	1466
25.399	68.3032	0	9.9614	0	1466
25.764	68.2686	0	9.9591	0	1466
26.432	68.2070	1	9.9593	0	1466
26.731	68.1769	0	9.9585	0	1533
27.862	68.0751	2	9.9580	2	1510
28.456	68.0214	0	9.9564	0	1553
28.724	67.9990	0	9.9544	0	1553
29.493	67.9286	1	9.9546	0	1560
29.756	67.9081	1	9.9531	0	1560
30.501	67.8379	0	9.9498	0	1560
33.462	67.4915	0	9.9238	0	1560
33.689	67.4694	0	9.9231	0	1560
34.357	67.4035	0	9.9255	0	1560
34.751	67.3740	0	9.9285	0	1560
35.352	67.3359	0	9.9311	1	1560
36.720	67.2506	0	9.9332	0	1560
38.972	67.0519	0	9.9247	0	1560
MARKER 7 FROM NEW GILBERT					
20.744	377.5678	2	2.0121	2	1670
24.651	377.4666	0	2.0294	0	1520
24.824	377.4641	1			1520
25.310	377.4516	1			1520
25.666	377.4451	0	2.0307	0	1520
25.883	377.4394	1	2.0320	0	1650
26.376	377.4265	1	2.0340	0	1650
26.674	377.3724	0			1650
26.858	377.4162	2			1650
27.378	377.4023	2	2.0388	0	1650
27.514	377.3997	0			1650
27.645	377.3993	0			1650
27.787	377.3923	1			1760

$\hat{t}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 7 FROM NEW GILBERT (cont.)					
27.894	377.3905	0			1760
28.376	377.3792	0	1.9952	0	1760
29.435	377.3542	1	2.0506	0	1760
30.361	377.3347	1	2.0532	0	1760
33.394	377.2434	1	2.0635	0	1760
33.586	377.2349	0	2.0624	0	1500
34.601	377.2117	0	2.0699	0	1500
36.736	377.1725	1	2.0780	0	1450
38.874	377.1283	2	2.0844	1	1310
39.484	377.1151	1	2.0895	2	1310
MARKER 7 FROM NEW QUICKIE					
20.828	51.6620	1	7.9851	1	1466
21.413	51.6212	0	7.9839	0	1466
21.703	51.5984	0	7.9829	0	1466
21.869	51.5864	0	7.9820	0	1466
23.460	51.4758	0	7.9773	0	1466
23.693	51.4594	0	7.9769	0	1466
24.303	51.4172	0	7.9752	0	1466
24.395	51.4105	0	7.9744	0	1466
24.670	51.3889	0	7.9742	0	1466
24.757	51.3828	0	7.9736	0	1466
24.885	51.3741	0	7.9733	0	1466
25.258	51.3516	0	7.9716	0	1466
25.396	51.3408	0	7.9725	0	1466
25.605	51.3266	0	7.9725	0	1466
25.761	51.3157	0	7.9732	0	1466
25.902	51.3069	0	7.9709	0	1466
26.290	51.2808	0	7.9695	0	1466
26.430	51.2721	0	7.9693	0	1466
26.591	51.2580	0	7.9675	0	1466
26.729	51.2509	0	7.9694	0	1466
26.894	51.2422	0	7.9686	0	1466
27.291	51.2137	0	7.9673	0	1510
27.435	51.2042	0	7.9677	0	1510
27.637	51.1904	0	7.9680	0	1510
27.760	51.1858	2	7.9679	2	1510
27.859	51.1773	2	7.9673	2	1510
28.388	51.1439	0	7.9656	0	1553
28.453	51.1405	0	7.9643	0	1553
28.583	51.1324	0	7.9650	0	1553
28.721	51.1231	0	7.9658	0	1553
28.880	51.1285	0	7.9674	0	1553
29.317	51.0872	1	7.9635	0	1560
29.481	51.0753	0	7.9637	0	1560
29.626	51.0663	1	7.9644	0	1560
29.753	51.0583	1	7.9644	0	1560
29.869	51.0504	1	7.9612	0	1560
30.361	51.0145	0	7.9613	0	1560
30.498	51.0083	0	7.9619	0	1560
31.544	50.9372	0	7.9561	0	1560
33.459	50.7540	0	7.9411	0	1560
33.555	50.7445	0	7.9405	0	1560
33.665	50.7385	0	7.9379	0	1560
33.872	50.7194	1	7.9415	0	1560
34.342	50.6922	0	7.9388	0	1560
34.497	50.6825	0	7.9391	1	1560
34.618	50.6771	0	7.9402	0	1560
34.762	50.6697	0	7.9394	0	1560
34.868	50.6635	0	7.9374	0	1560
35.338	50.6471	0	7.9333	0	1560
35.473	50.6402	0	7.9387	1	1560
35.614	50.6280	0	7.9392	0	1560
36.705	50.5844	1	7.9436	0	1560
36.865	50.5746	0	7.9415	0	1560
39.356	50.4420	0	7.9397	0	1560
39.466	50.4364	0	7.9399	0	1560
MARKER 8 FROM NEW GILBERT					
24.681	371.1931	0	2.6665	0	1520
24.825	371.1880	1			1520
25.312	371.1678	1			1520
25.671	371.1508	0	2.6720	0	1520
25.884	371.1436	1	2.6672	0	1650
26.378	371.1207	1	2.6738	0	1650
26.636	371.1121	0			1650
26.860	371.1017	2			1650
27.380	371.0774	2	2.6770	0	1650
27.515	371.0710	0			1650
27.649	371.0692	0			1650
27.788	371.0606	1			1760
27.894	371.0561	0			1760
28.367	371.0361	0	2.6830	0	1760
28.510	371.0293	0			1760
28.634	371.0273	0			1760

i	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 8 FROM NEW GILBERT (cont.)					
28.757	371.0231	0			1760
28.876	371.0122	0			1760
29.433	370.9930	1	2.6892	0	1760
29.503	370.9902	0			1760
29.629	370.9848	0			1760
29.757	370.9784	0			1760
29.883	370.9737	0			1760
30.363	370.9558	1	2.6928	0	1760
30.588	370.9456	2			1760
30.625	370.9448	0			1760
30.750	370.9393	0			1760
31.493	370.9081	1	2.6973	0	1760
33.387	370.7935	1	2.7077	0	1760
33.589	370.7804	0	2.7074	0	1500
33.711	370.7760	0			1500
33.834	370.7694	0			1500
34.335	370.7425	1			1500
34.463	370.7416	0			1500
34.603	370.7367	0	2.7135	1	1500
34.715	370.7316	0			1500
34.835	370.7254	0			1450
35.343	370.7087	0			1450
36.644	370.6666	1			1450
36.794	370.6608	0	2.7258	0	1450
38.835	370.5868	0	2.7290	0	1310
39.335	370.5667	0			1310
39.485	370.5596	1	2.7333	1	1310
39.598	370.5605	0			1310
39.718	370.5549	0			1310
40.340	370.5329	0			1310
40.696	370.5234	0			1750
40.833	370.5198	1			1750
41.376	370.5012	0	2.7468	0	1750
41.556	370.4947	0			1750
41.683	370.4925	1			1750
41.803	370.4871	0			1750
42.511	370.4658	0			1750
42.799	370.4519	3			1750
43.448	370.4397	1	2.7604	0	1560
43.556	370.4284	1			1560
43.701	370.4237	1			1620
43.799	370.4186	1			1620
44.387	370.4022	1	2.7619	0	1620
44.474	370.3950	1			1620
44.600	370.3913	1			1620
44.721	370.3880	0			1620
44.833	370.3838	0			1620
45.357	370.3653	0	2.7652	3	1620
45.467	370.3608	3			1620
45.588	370.3560	1			1620
45.715	370.3540	0			1620
45.835	370.3471	1			1620
46.351	370.3296	1	2.7688	0	1620
46.469	370.3242	0			1620
46.582	370.3208	0			1620
46.714	370.3155	1			1620
46.827	370.3103	1			1620
47.381	370.2916	1	2.7752	0	1620
47.462	370.2872	1			1620
47.583	370.2820	1			1620
47.708	370.2814	1			1620
47.832	370.2744	1			1620
48.350	370.2616	1	2.7782	0	1620
MARKER 8 FROM NEW QUICKIE					
24.644	41.0032	0	6.8885	1	1466
25.672	40.9632	1	6.8842	0	1466
26.537	40.9269	0	6.8820	0	1466
27.526	40.8890	0	6.8786	0	1510
28.377	40.8550	2	6.8728	2	1553
29.529	40.8150	0	6.8707	0	1560
30.378	40.7797	0	6.8661	0	1560
33.772	40.6222	1	6.8477	0	1560
34.488	40.5917	0	6.8442	0	1560
39.491	40.4396	0	6.8322	0	1560
MARKER 9 FROM NEW GILBERT					
24.684	365.4966	0	3.0944	0	1520
24.829	365.4882	1			1520
25.315	365.4591	1			1520
25.672	365.4326	0	3.0975	0	1520
25.885	365.4269	1	3.1001	0	1650
26.381	365.3907	1	3.1015	0	1650
26.679	365.3783	0			1650

i	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 9 FROM NEW GILBERT (cont.)					
26.694	365.3666	1			1650
27.382	365.3294	2	3.1082	0	1550
27.517	365.3200	0			1650
27.651	365.3175	0			1650
27.790	365.3064	1			1760
27.896	365.2984	0			1760
28.369	365.2686	0	3.1103	0	1760
28.515	365.2615	0			1760
28.640	365.2561	0			1760
28.758	365.2479	0			1760
28.878	365.2418	0			1760
29.457	365.2074	1	3.1156	0	1760
29.506	365.2032	0			1760
29.630	365.1979	0			1760
29.759	365.1882	0			1760
29.884	365.1810	0			1760
30.365	365.1543	1			1760
30.589	365.1400	2			1760
30.628	365.1392	0			1760
30.751	365.1304	0			1760
31.494	365.0852	1	3.1243	0	1760
33.389	364.9225	1	3.1309	0	1760
33.591	364.9069	0	3.1311	0	1500
33.713	364.8996	0			1500
33.835	364.8863	1			1500
34.337	364.8539	1			1500
34.465	364.8506	0			1500
34.605	364.8440	0	3.1366	0	1500
34.716	364.8356	0			1500
34.836	364.8274	0			1450
35.344	364.8022	0			1450
35.462	364.7953	2			1450
36.645	364.7405	1			1450
36.796	364.7330	0	3.1451	0	1450
38.837	364.6195	0	3.1509	0	1310
39.336	364.5899	0			1310
39.486	364.5833	1	3.1568	1	1310
39.599	364.5808	0			1310
39.719	364.5733	0			1310
40.342	364.5387	1			1310
40.702	364.5220	0			1750
40.834	364.5196	1			1750
41.378	364.4918	0	3.1685	0	1750
41.556	364.4818	0			1750
41.684	364.4776	1			1750
41.804	364.4712	0			1750
42.515	364.4379	0			1750
42.802	364.4192	3			1750
43.451	364.3920	1	3.1839	0	1560
43.557	364.3847	1			1560
43.703	364.3796	1			1620
43.800	364.3718	1			1620
44.390	364.3433	1	3.1879	0	1620
44.474	364.3357	1			1620
44.601	364.3296	1			1620
44.724	364.3240	0			1620
44.834	364.3179	0			1620
45.358	364.2917	0	3.1906	0	1620
45.468	364.2833	1			1620
45.589	364.2778	1			1620
45.717	364.2713	0			1620
45.836	364.2652	1			1620
46.353	364.2360	1	3.1938	0	1620
46.469	364.2280	0			1620
46.583	364.2229	0			1620
46.715	364.2168	1			1620
46.828	364.2065	1			1620
47.384	364.1823	1	3.2011	0	1620
47.464	364.1741	2			1620
47.583	364.1723	1			1620
47.708	364.1651	1			1620
47.833	364.1565	0			1620
48.351	364.1368	1	3.2042	0	1620
MARKER 9 FROM NEW QUICKIE					
24.649	36.5108	0	6.1959	1	1466
25.669	36.4895	1	6.1931	1	1466
26.535	36.4692	0	6.1878	0	1466
27.524	36.4485	0	6.1835	0	1510
28.374	36.4315	2	6.1820	2	1553
29.531	36.4072	0	6.1757	0	1560
30.380	36.3858	0	6.1715	0	1560
33.767	36.2986	0	6.1499	0	1560
34.485	36.2814	0	6.1467	0	1560
39.488	36.1943	0	6.1317	1	1560

i	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 10 FROM NEW GILBERT					
24.685	355.3597	1	3.5160	1	1520
24.831	355.3443	1			1520
25.313	355.2994	1			1520
25.674	355.2642	0	3.5240	0	1520
25.888	355.2424	1	3.5247	0	1650
26.383	355.1933	1	3.5338	0	1650
26.680	355.1666	0			1650
26.863	355.1398	2			1650
27.383	355.0952	2	3.5423	0	1650
27.518	355.0837	0			1650
27.653	355.0745	0			1650
27.790	355.0618	1			1760
27.901	355.0492	0			1760
28.372	355.0055	0	3.5517	0	1760
28.517	354.9920	0			1760
28.637	354.9828	0			1760
28.759	354.9712	0			1760
28.879	354.9603	0			1760
29.414	354.9096	1	3.5622	0	1760
29.506	354.9025	0			1760
29.633	354.8910	0			1760
29.760	354.8780	0			1760
29.885	354.8660	0			1760
30.366	354.8215	1			1760
30.590	354.8009	2			1760
30.629	354.7993	0			1760
30.751	354.7873	0			1760
31.485	354.7163	1	3.5795	0	1760
33.386	354.4727	1	3.5976	0	1760
33.647	354.4412	0	3.5996	0	1500
33.716	354.4341	0			1500
33.836	354.4207	0			1500
34.338	354.3654	1			1500
34.461	354.3571	0			1500
34.608	354.3450	0	3.6098	0	1500
34.717	354.3338	0			1500
34.837	354.3207	0			1450
35.346	354.2807	0			1450
36.646	354.1795	1			1450
36.797	354.1663	0	3.6265	0	1450
38.840	353.9851	0	3.6423	0	1310
39.337	353.9389	0			1310
39.488	353.9277	2	3.6493	2	1310
39.600	353.9165	0			1310
39.721	353.9055	0			1310
40.344	353.8384	1			1310
40.702	353.7675	0			1750
40.835	353.8052	1			1750
41.379	353.7596	0	3.6799	0	1750
41.557	353.7425	0			1750
41.685	353.7360	1			1750
41.805	353.7259	0			1750
42.515	353.6707	0			1750
42.806	353.6388	3			1750
43.453	353.5953	1	3.7010	0	1560
43.558	353.5895	1			1560
43.706	353.5738	1			1620
43.801	353.5678	1			1620
44.392	353.5189	1	3.7095	0	1620
44.475	353.5094	1			1620
44.603	353.5013	1			1620
44.724	353.4925	0			1620
44.835	353.4819	0			1620
45.360	353.4384	0	3.7168	0	1620
45.469	353.4259	1			1620
45.590	353.4181	1			1620
45.717	353.4078	0			1620
45.837	353.3964	1			1620
46.354	353.3492	1	3.7242	0	1620
46.471	353.3370	0			1620
46.585	353.3287	0			1620
46.718	353.3192	1			1620
46.829	353.3086	1			1620
47.385	353.2615	1	3.7346	0	1620
47.465	353.2521	1			1620
47.585	353.2445	1			1620
47.710	353.2349	1			1620
47.833	353.2208	0			1620
48.353	353.1900	1	3.7424	0	1620

$\hat{f}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 10 FROM NEW QUICKIE					
24.655	34.4912	0	5.4167	1	1466
25.666	34.4834	1	5.4176	0	1466
26.533	34.4738	0	5.4175	0	1466
27.522	34.4640	0	5.4169	0	1510
28.370	34.4646	2	5.4155	2	1553
29.536	34.4457	0	5.4150	0	1560
30.381	34.4358	0	5.4151	0	1560
33.764	34.3962	0	5.4116	0	1560
34.483	34.3879	0	5.4074	0	1560
39.485	34.3520	0	5.4139	0	1560
MARKER 11 FROM NEW GILBERT					
24.688	345.2078	0	4.0817	0	1520
24.833	345.1897	1			1520
25.317	345.1335	1			1520
25.676	345.0916	0	4.0872	0	1520
25.890	345.0685	1	4.0882	0	1650
26.385	345.0067	1	4.0927	0	1650
26.688	344.9716	0			1650
26.865	344.9446	2			1650
27.385	344.8892	2	4.0979	0	1650
27.519	344.8722	0			1650
27.654	344.8596	0			1650
27.792	344.8430	1			1760
27.898	344.8311	0			1760
28.373	344.7749	0	4.1065	0	1760
29.406	344.6554	1	4.1121	0	1760
30.367	344.5522	1	4.1186	0	1760
31.499	344.4205	1	4.1253	0	1760
33.385	344.1356	1	4.1360	0	1760
33.596	344.1015	1	4.1335	0	1500
34.610	343.9784	0	4.1402	0	1500
36.707	343.7655	2	4.1504	1	1450
38.876	343.5236	2	4.1619	1	1310
39.488	343.4547	2	4.1671	1	1310
41.383	343.2611	1	4.1846	0	1750
43.456	343.0473	1	4.1981	0	1560
44.393	342.9548	0	4.2045	0	1620
45.364	342.8508	0	4.2093	1	1620
46.354	342.7398	1	4.2140	0	1620
47.386	342.6256	2	4.2204	0	1620
48.354	342.5245	1	4.2249	0	1620
MARKER 11 FROM NEW QUICKIE					
24.658	33.1292	0	5.0655	1	1466
25.663	33.1252	1	5.0644	0	1466
26.532	33.1212	0	5.0592	0	1466
27.520	33.1113	1	5.0537	0	1510
28.367	33.1198	2	5.0514	2	1553
29.544	33.1134	1	5.0484	0	1560
30.387	33.1035	0	5.0466	0	1560
33.753	33.0872	1	5.0354	1	1560
34.481	33.0798	0	5.0330	1	1560
MARKER 12 FROM NEW GILBERT					
24.690	341.0571	0	4.3142	0	1520
24.834	341.0367	1			1520
25.318	340.9742	1			1520
25.678	340.9267	0	4.3216	0	1520
25.891	340.8979	1	4.3268	0	1650
26.387	340.8314	1	4.3311	0	1650
26.690	340.7937	0			1650
26.871	340.7629	2			1650
MARKER 12 FROM NEW QUICKIE					
24.660	31.8110	0	4.9099	1	1466
25.660	31.8088	1	4.9075	0	1466
26.531	31.8043	0	4.9114	0	1466
27.506	31.8037	1	4.9034	0	1510
28.353	31.8030	2	4.9012	2	1553
29.547	31.8063	0	4.9000	0	1560
30.388	31.7904	0	4.8986	0	1560
34.475	31.7684	0	4.8863	1	1560
MARKER 13 FROM NEW GILBERT					
25.440	391.8712	1	1.3877	1	1520
25.905	391.8714	1	1.3838	0	1650
26.408	391.8684	1	1.3868	0	1650
27.403	391.8651	2	1.3859	0	1650
28.383	391.8537	0	1.3888	0	1760
29.479	391.8547	0	1.3888	0	1760
30.379	391.8522	1	1.3907	0	1760
33.408	391.8334	1	1.3899	0	1760

$\hat{f}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 13 FROM NEW GILBERT (cont.)					
33.649	391.8319	0	1.3924	0	1500
34.628	391.8287	0	1.3931	0	1500
36.697	391.8224	1	1.3928	0	1450
39.488	391.8082	2	1.3928	1	1310
41.397	391.8055	0	1.3982	0	1750
43.454	391.8028	1	1.3968	1	1560
44.406	391.7963	1	1.4008	0	1620
45.374	391.7939	0	1.4007	0	1620
46.363	391.7894	1	1.4000	0	1620
47.397	391.7876	1	1.4040	0	1620
48.353	391.7840	1	1.4015	0	1620
MARKER 13 FROM NEW QUICKIE					
25.432	102.0918	0	15.8804	0	1466
25.774	102.0593	1	15.8814	1	1466
25.910	102.0484	0	15.8826	0	1466
26.294	102.0127	0	15.8817	0	1466
26.442	101.9997	0	15.8855	0	1466
26.608	101.9844	0	15.8839	0	1466
26.740	101.9704	1	15.8850	0	1466
26.753	101.9762	0	15.8852	0	1466
26.902	101.9572	0	15.8849	0	1466
27.299	101.9203	0	15.8884	0	1510
27.440	101.9077	0	15.8886	0	1510
27.649	101.8914	0	15.8898	0	1510
27.766	101.8887	2	15.8897	2	1510
27.874	101.8666	2	15.8896	2	1510
28.392	101.8217	0	15.8921	0	1553
28.469	101.8234	0	15.8917	0	1553
28.587	101.8049	0	15.8920	0	1553
28.733	101.7928	0	15.8906	0	1553
28.875	101.8049	0	15.8929	0	1553
29.321	101.7445	1	15.8942	0	1560
29.501	101.7196	0	15.8940	0	1560
29.629	101.7085	1	15.8955	0	1560
29.765	101.7004	1	15.8947	0	1560
29.872	101.6880	1	15.8963	0	1560
30.363	101.6370	0	15.8949	0	1560
30.520	101.6191	1	15.8966	0	1560
31.547	101.5339	2	15.8975	0	1560
33.471	101.2259	0	15.8973	0	1560
33.583	101.2121	0	15.9022	1	1560
33.672	101.2087	0	15.8991	0	1560
33.878	101.1773	0	15.9025	0	1560
34.346	101.1390	0	15.9006	0	1560
34.503	101.1256	0	15.9021	0	1560
34.622	101.1202	0	15.9044	0	1560
34.767	101.1082	0	15.9028	0	1560
34.873	101.1025	0	15.9053	0	1560
35.342	101.0751	1	15.9093	1	1560
35.479	101.0702	1	15.9065	0	1560
35.619	101.0582	0	15.9069	0	1560
36.709	100.9980	0	15.9080	0	1560
36.871	100.9817	0	15.9090	0	1560
39.360	100.7874	0	15.9116	0	1560
39.470	100.7849	0	15.9120	0	1560
MARKER 14 FROM NEW GILBERT					
25.438	381.2745	1	1.0136	1	1520
26.415	381.2629	0	1.0166	0	1650
27.405	381.2562	2	1.0139	0	1650
28.384	381.2442	0	1.0325	0	1760
29.480	381.2339	0	1.0215	0	1760
30.378	381.2264	1	1.0232	0	1760
MARKER 14 FROM NEW QUICKIE					
25.438	102.1683	0	7.2097	0	1466
25.781	102.1338	1	7.2076	1	1466
25.913	102.1240	0	7.2140	0	1466
26.297	102.0896	0	7.2162	0	1466
26.444	102.0762	0	7.2156	0	1466
26.613	102.0611	0	7.2166	1	1466
26.743	102.0454	1	7.2168	0	1466
26.757	102.0477	0	7.2174	0	1466
26.904	102.0326	0	7.2166	0	1466
27.301	101.9973	0	7.2216	0	1510
27.442	101.9856	0	7.2223	0	1510
27.644	101.9692	0	7.2245	0	1510
27.769	101.9698	2	7.2246	2	1510
27.872	101.9455	2	7.2234	2	1510
28.394	101.9009	0	7.2280	0	1553
28.469	101.8998	0	7.2293	0	1553
28.588	101.8856	0	7.2299	0	1553
28.733	101.8755	0	7.2291	0	1553
28.874	101.8874	0	7.2319	0	1553

$\hat{f}$	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 14 FROM NEW QUICKIE (cont.)					
29.322	101.8258	1	7.2330	0	1560
29.502	101.8044	0	7.2356	0	1560
29.628	101.7928	1	7.2360	0	1560
29.766	101.7856	1	7.2361	1	1560
29.874	101.7721	1	7.2365	0	1560
30.364	101.7259	0	7.2387	0	1560
30.519	101.7033	1	7.2400	0	1560
31.548	101.6271	0	7.2432	0	1560
33.479	101.3680	0	7.2593	0	1560
33.717	100.9735	1	7.1693	1	1560
33.892	100.9534	0	7.1765	1	1560
34.349	100.9178	0	7.1769	0	1560
34.505	100.9033	0	7.1764	0	1560
34.624	100.8972	1	7.1772	0	1560
34.769	100.8863	0	7.1764	0	1560
34.875	100.8809	0	7.1795	0	1560
35.344	100.8534	0	7.1795	0	1560
35.622	100.8341	0	7.1806	0	1560
36.712	100.7683	0	7.1874	1	1560
39.365	100.5699	0	7.1909	0	1560
39.472	100.5647	0	7.1942	0	1560
MARKER 15 FROM NEW GILBERT					
24.721	332.7303	0	5.9608	2	1520
24.845	332.7298	1			1520
25.324	332.7234	1			1520
25.696	332.7145	1	5.9592	1	1520
25.900	332.7159	1	5.9622	0	1650
26.403	332.7078	1	5.9620	0	1650
26.691	332.7034	0			1650
26.874	332.7078	2			1650
27.398	332.6916	2	5.9071	0	1650
27.529	332.6941	0			1650
27.661	332.6941	0			1650
27.799	332.6922	1			1760
27.904	332.6914	0			1760
28.378	332.6843	0	5.9699	0	1760
29.402	332.6756	1	5.9724	0	1760
30.374	332.6675	1	5.9734	0	1760
31.505	332.6558	1	5.9781	0	1760
33.381	332.6340	1	5.9853	0	1760
33.610	332.6279	0	5.9833	0	1500
34.621	332.6224	0	5.9866	0	1500
36.678	332.6075	2	5.9876	0	1450
39.483	332.5842	2	5.9929	1	1310
41.386	332.5740	0	6.0049	0	1750
43.460	332.5573	1	6.0111	1	1560
44.398	332.5558	1	6.0127	0	1620
45.367	332.5533	0	6.0146	0	1620
46.356	332.5488	1	6.0168	0	1620
47.387	332.5453	1	6.0195	0	1620
48.355	332.5445	1	6.0213	0	1620
MARKER 15 FROM NEW QUICKIE					
24.600	21.5716	0	4.6367	0	1466
25.638	21.5716	0	4.6385	0	1466
26.521	21.5705	0	4.6284	1	1466
27.496	21.5696	0	4.6379	0	1510
28.343	21.5689	2	4.6386	2	1553
29.556	21.5738	0	4.6426	1	1560
30.396	21.5684	0	4.6418	0	1560
33.725	21.5639	0	4.6480	0	1560
34.466	21.5637	0	4.6460	0	1560
MARKER 16 FROM NEW GILBERT					
24.712	331.5155	0	3.8130	2	1520
24.835	331.4977	1			1520
25.319	331.4377	1			1520
25.688	331.3903	1	3.8210	1	1520
25.894	331.3650	1	3.8240	0	1650
26.390	331.3009	1	3.8320	0	1650
26.686	331.2651	0			1650
26.869	331.2376	2			1650
27.391	331.1740	2	3.8406	0	1650
27.522	331.1544	0			1650
27.656	331.1456	0			1650
27.794	331.1234	1			1760
27.899	331.1115	0			1760
28.374	331.0518	0	3.8641	0	1760
29.401	330.9279	1	3.8601	0	1760
30.369	330.8099	1	3.8679	0	1760
31.500	330.6654	1	3.8774	0	1760
33.383	330.3567	1	3.8952	0	1760
33.601	330.3177	1	3.8968	0	1500
34.614	330.1724	1	3.9064	0	1500

f	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 17 FROM NEW GILBERT					
24.714	332.2609	0	4.1610	1	1520
24.837	332.2393	1			1520
25.321	332.1694	1			1520
25.690	332.1133	1	4.1700	1	1520
25.895	332.0823	1	4.1742	0	1650
26.392	332.0045	1	4.1811	0	1650
26.688	331.9607	1			1650
26.871	331.9296	2			1650
27.393	331.8510	2	4.1907	0	1650
27.524	331.8299	0			1650
27.658	331.8135	0			1650
27.796	331.7919	1			1760
27.900	331.7749	0			1760
28.368	331.7027	0	4.2057	0	1760
28.519	331.6802	0			1760
28.637	331.6634	0			1760
28.760	331.6476	0			1760
28.881	331.6274	0			1760
29.399	331.5483	1	4.2231	0	1760
29.507	331.5305	0			1760
29.632	331.5108	0			1760
29.761	331.4907	0			1760
29.885	331.4703	0			1760
30.370	331.3925	1	4.2439	0	1760
30.590	331.3551	2			1760
30.630	331.3504	0			1760
30.752	331.3295	0	4.2439	0	1760
MARKER 17 FROM NEW QUICKIE					
24.628	35.4431	0	4.6262	1	1466
25.649	35.4232	0	4.6283	0	1466
26.527	35.4027	0	4.6267	0	1466
27.509	35.3824	0	4.6288	0	1510
28.363	35.3494	3	4.6290	2	1553
MARKER 18 FROM NEW QUICKIE					
24.625	31.9380	0	4.7001	0	1466
25.645	31.9300	1	4.6956	1	1466
26.526	31.9185	0	4.6936	0	1466
27.503	31.9091	1	4.6896	0	1510
28.351	31.9043	3	4.6873	2	1553
29.546	31.8953	0	4.6813	0	1560
30.389	31.8758	0	4.6854	0	1560
34.473	31.8150	0	4.6841	0	1560
MARKER 19 FROM NEW GILBERT					
24.716	333.1033	0	5.1200	1	1520
24.839	333.0803	1			1520
25.322	332.9964	1			1520
25.692	332.9304	1	5.1295	1	1520
25.897	332.8959	1	5.1370	0	1650
26.393	332.8089	1	5.1440	0	1650
26.689	332.7547	1			1650
26.872	332.7610	2			1650
27.395	332.6350	2	5.1592	0	1650
27.526	332.6124	0			1650
27.659	332.5933	0			1650
27.797	332.5673	1			1760
27.901	332.5620	0			1760
28.376	332.4657	0	5.1737	0	1760
28.519	332.4444	0			1760
28.639	332.4282	0			1760
28.762	332.4082	0			1760
28.881	332.3837	0			1760
29.400	332.2999	1	5.1889	0	1760
29.508	332.2815	0			1760
29.633	332.2605	0			1760
29.762	332.2386	0			1760
29.887	332.2165	0			1760
30.372	332.1347	1	5.2026	0	1760
30.592	332.0966	2			1760
30.631	332.0933	0			1760
30.753	332.0693	0			1760
31.502	331.9385	1	5.2179	0	1760
33.378	331.5217	1	5.2537	0	1760
33.606	331.4742	1	5.2545	0	1500
33.721	331.4524	0			1500
33.837	331.4296	0			1500
34.340	331.3340	1			1500
34.468	331.3160	0			1500
34.617	331.2919	0	5.2708	0	1500
34.719	331.2741	0			1500
34.839	331.2531	0			1450
35.346	331.1746	0			1450

f	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 19 FROM NEW GILBERT (cont.)					
35.467	331.1586	2			1450
36.659	330.9835	1			1450
36.799	330.9639	0	5.3003	0	1450
38.841	330.6349	1	5.3304	1	1310
39.340	330.5554	0			1310
39.481	330.5322	2	5.3408	2	1310
39.601	330.5194	0			1310
39.722	330.4997	0			1310
40.346	330.4081	2			1310
40.701	330.3516	0			1750
40.835	330.3338	1			1750
41.384	330.2502	0	5.3779	0	1750
41.558	330.2253	0			1750
41.685	330.2078	1			1750
41.806	330.1921	0			1750
42.517	330.0890	0			1750
42.809	330.0471	3			1750
43.458	329.9506	1	5.4090	0	1560
43.560	329.9411	1			1560
43.707	329.9196	1			1620
43.803	329.9059	1			1620
44.396	329.8189	1	5.4211	0	1620
44.476	329.8060	1			1620
44.604	329.7888	1			1620
44.725	329.7711	0			1620
44.836	329.7551	0			1620
45.365	329.6731	0	5.4392	0	1620
45.469	329.6537	1			1620
45.592	329.6385	1			1620
MARKER 19 FROM NEW QUICKIE					
24.633	27.4748	0	4.7341	0	1466
25.643	27.4810	0	4.7362	1	1466
26.524	27.4846	0	4.7363	0	1466
27.501	27.4868	1	4.7380	0	1510
28.348	27.4958	2	4.7380	2	1553
29.555	27.4982	0	4.7413	0	1560
30.392	27.4934	0	4.7434	0	1560
33.736	27.5011	1	4.7517	0	1560
34.470	27.5022	0	4.7550	0	1560
MARKER 20 FROM NEW GILBERT					
24.719	333.6437	0	5.6214	1	1520
24.842	333.6268	1			1520
25.323	333.5698	1			1520
25.694	333.5219	1	5.6317	1	1520
25.899	333.5005	1	5.6408	0	1650
26.401	333.4373	1	5.6433	0	1650
26.690	333.3995	1			1650
26.873	333.3816	2			1650
27.396	333.3174	2	5.6572	0	1650
27.527	333.3050	0			1650
27.660	333.2906	0			1650
27.756	333.2666	1			1760
27.903	333.2606	0			1760
28.377	333.2057	0	5.6712	0	1760
28.521	333.1924	0			1760
28.639	333.1779	0			1760
28.762	333.1643	0			1760
28.883	333.1495	0			1760
29.402	333.0928	0	5.6831	0	1760
29.509	333.0801	0			1760
29.633	333.0668	0			1760
29.763	333.0506	0			1760
29.887	333.0353	0			1760
30.372	332.9808	1	5.6951	0	1760
30.592	332.9545	2			1760
30.631	332.9525	0			1760
30.753	332.9372	0			1760
31.503	332.8473	1	5.7112	0	1760
33.379	332.5534	1	5.7422	0	1760
33.608	332.5161	0	5.7436	0	1500
33.724	332.5045	0			1500
33.838	332.4877	0			1500
34.342	332.4223	1			1500
34.469	332.4105	0			1500
34.619	332.3961	0	5.7568	0	1500
34.720	332.3820	0			1500
34.840	332.3673	0			1450
35.348	332.3153	0			1450
35.469	332.3031	2			1450
36.664	332.1855	1			1450
36.800	332.1720	0	5.7837	1	1450
38.843	331.9416	0	5.8074	0	1310
39.341	331.8845	0			1310

f	$\hat{\theta}$	K_θ	ϕ	K_ϕ	h
MARKER 20 FROM NEW GILBERT (cont.)					
39.483	331.8693	2	5.8176	1	1310
39.602	331.8615	0			1310
39.724	331.8492	0			1310
40.347	331.7781	2			1310
40.704	331.7428	0			1750
40.836	331.7347	1			1750
41.385	331.6786	0	5.8515	0	1750
41.559	331.6612	0			1750
41.686	331.6489	1			1750
41.806	331.6380	0			1750
MARKER 20 FROM NEW QUICKIE					
24.605	24.9106	0	4.8117	0	1466
25.640	24.9198	0	4.8171	1	1466
26.522	24.9292	0	4.8176	0	1466
27.498	24.9394	1	4.8206	0	1510
28.346	24.9455	2	4.8213	2	1553
29.556	24.9639	0	4.8296	0	1560
30.393	24.9675	0	4.8282	0	1560
MARKER 21 FROM NEW GILBERT					
21.726	361.0543	0	2.2046	0	1520
24.739	360.9665	0	2.2182	0	1520
24.846	360.9644	1			1520
25.326	360.9523	1			1520
25.901	360.9364	1	2.2218	0	1650
26.405	360.9204	1	2.2214	0	1650
27.399	360.8939	1	2.2256	0	1650
28.379	360.8675	0	2.2308	0	1760
29.440	360.8400	1	2.2367	0	1760
30.376	360.8120	1	2.2386	0	1760
31.508	360.7789	1	2.2453	0	1760
33.404	360.7055	1	2.2520	0	1760
33.613	360.6965	0	2.2504	0	1500
34.624	360.6704	0	2.2558	0	1500
36.738	360.6251	1	2.2635	0	1450
38.884	360.5726	2	2.2707	1	1310
39.485	360.5579	1	2.2748	1	1310
41.388	360.5187	0	2.2893	0	1750
43.449	360.4707	1	2.2997	0	1560
44.402	360.4538	1	2.3027	0	1620
45.371	360.4313	0	2.3061	0	1620
46.360	360.4086	1	2.3099	0	1620
47.390	360.3844	1	2.3137	0	1620
48.350	360.3597	1	2.3180	0	1620
MARKER 21 FROM NEW QUICKIE					
21.724	55.1703	0	5.6040	0	1466
23.479	55.1061	0	5.6046	0	1466
24.892	55.0504	0	5.6041	0	1466
25.797	55.0174	0	5.6044	0	1466
27.529	54.9562	1	5.6055	0	1510
28.380	54.9262	2	5.6064	2	1553
29.525	54.8868	0	5.6084	0	1560
30.376	54.8544	0	5.6087	0	1560
33.760	54.7066	0	5.6142	1	1560
34.491	54.6807	0	5.6137	0	1560
39.493	54.5417	0	5.6268	0	1560
MARKER 22 FROM NEW GILBERT					
21.708	395.5429	0	1.8134	0	1520
24.731	395.5389	0	1.8134	0	1520
24.846	395.5398	1			1520
25.326	395.5399	1			1520
25.903	395.5401	1	1.8105	0	1650
26.407	395.5390	1	1.8149	0	1650
27.399	395.5388	2	1.8131	0	1650
28.381	395.5371	0	1.8161	0	1760
29.443	395.5376	1	1.8175	0	1760
30.379	395.5393	1	1.8188	0	1760
31.509	395.5377	1	1.8213	0	1760
33.406	395.5388	1	1.8209	0	1760
33.615	395.5383	0	1.8191	0	1500
34.626	395.5405	0	1.8191	0	1500
36.701	395.5397	1	1.8215	0	1450
39.483	395.5376	2	1.8240	1	1310
41.393	395.5420	0	1.8298	0	1750
43.451	395.5351	1	1.8346	0	1560
44.404	395.5399	1	1.8344	0	1620
45.372	395.5416	0	1.8352	0	1620
46.361	395.5409	1	1.8358	0	1620
47.396	395.5402	1	1.8398	0	1620
48.351	395.5372	1	1.8367	0	1620

Appendix 2. Laser-measured distances to marker 11.

The time shown $\hat{t}$ is 200 less than the 1984 Julian Day, which is 214.0000 at 0000 hours on August 1, 1984 and increases by 1 each day thereafter. The actual measured distance $\hat{r}$ and the distance r adjusted for variation in atmospheric density are both 3 km more than the value that is given here in mm. Adjusted values for the first four readings are absent because of the unavailability of meteorological data then.

$\hat{t}$	$\hat{r}$	r	$\hat{t}$	$\hat{r}$	r	$\hat{t}$	$\hat{r}$	r	$\hat{t}$	$\hat{r}$	r	$\hat{t}$	$\hat{r}$	r
21.5729	818739													
21.5833	818639		25.5521	779850	779837	26.2708	772882	772854	27.0521	765347	765318	28.1146	755488	755455
21.6049	818435		25.5625	779742	779729	26.3028	772575	772548	27.0729	765165	765135	28.1250	755401	755368
21.7069	817399		25.5840	779557	779545	26.3229	772365	772340	27.0938	764948	764917	28.1354	755309	755276
24.7292	787755	787733	25.5944	779444	779433	26.3333	772268	772243	27.1042	764873	764841	28.1458	755220	755187
24.7403	787640	787618	25.6042	779351	779341	26.3438	772171	772147	27.1146	764767	764735	28.1563	755128	755094
24.7500	787541	787518	25.6146	779249	779239	26.3542	772074	772051	27.1250	764695	764663	28.1667	755038	755004
24.7604	787440	787417	25.6250	779145	779136	26.3646	771970	771948	27.1354	764602	764570	28.1771	754948	754914
24.7708	787336	787312	25.6354	779038	779029	26.3750	771864	771843	27.1458	764509	764477	28.1875	754858	754824
24.7813	787212	787188	25.6458	778953	778944	26.3958	771663	771643	27.1563	764417	764385	28.1979	754766	754732
24.7931	787100	787076	25.6563	778858	778850	26.4063	771556	771536	27.1771	764229	764197	28.2083	754675	754641
24.8021	787015	786990	25.6667	778730	778722	26.4167	771460	771441	27.1875	764134	764102	28.2188	754589	754555
24.8125	786916	786891	25.6771	778655	778647	26.4271	771377	771358	27.1979	764048	764016	28.2292	754495	754462
24.8333	786690	786664	25.6875	778535	778527	26.4375	771269	771250	27.2083	763949	763917	28.2396	754403	754370
24.8438	786585	786559	25.6979	778452	778444	26.4479	771163	771145	27.2292	763749	763718	28.2500	754316	754283
24.8542	786474	786448	25.7188	778228	778220	26.4688	770964	770946	27.2396	763649	763618	28.2604	754219	754187
24.8750	786276	786250	25.7292	778137	778129	26.4792	770869	770851	27.2500	763552	763522	28.2708	754133	754101
24.8854	786158	786132	25.7396	778006	777998	26.4896	770759	770741	27.2708	763352	763322	28.2813	754038	754006
24.8958	786054	786028	25.7500	777915	777906	26.5000	770673	770656	27.2813	763268	763239	28.2917	753945	753914
24.9174	785842	785816	25.7604	777804	777795	26.5313	770370	770354	27.3021	763077	763049	28.3021	753863	753832
24.9271	785755	785729	25.7708	777680	777670	26.5417	770265	770249	27.3125	762986	762958	28.3542	753386	753357
24.9583	785451	785425	25.7813	777593	777583	26.5625	770074	770058	27.3229	762892	762864	28.3750	753196	753168
24.9688	785334	785307	25.8854	776536	776518	26.5729	769989	769974	27.3333	762779	762752	28.3854	753096	753069
24.9792	785237	785210	25.8958	776444	776425	26.5833	769880	769865	27.3438	762698	762671	28.3958	753008	752981
25.0104	784948	784921	25.9063	776343	776323	26.5938	769788	769773	27.3542	762590	762563	28.4063	752906	752880
25.0208	784855	784828	25.9167	776226	776205	26.6042	769692	769678	27.3646	762490	762463	28.4167	752820	752794
25.0417	784659	784632	25.9271	776127	776105	26.6153	769595	769581	27.5965	760349	760327	28.4271	752746	752721
25.0521	784574	784546	25.9375	776024	776002	26.6250	769498	769485	27.6424	759942	759921	28.4479	752540	752516
25.0625	784479	784451	25.9479	775920	775897	26.6354	769401	769388	27.7160	759240	759219	28.4583	752449	752426
25.0833	784286	784257	25.9583	775834	775811	26.6458	769290	769278	27.7382	759027	759005	28.4688	752348	752325
25.0938	784190	784161	25.9792	775619	775595	26.6667	769090	769079	27.7611	758812	758789	28.4896	752141	752119
25.1250	783887	783857	25.9903	775530	775505	26.6771	768997	768986	27.7861	758559	758535	28.5000	752049	752028
25.1354	783798	783769	26.0000	775429	775404	26.6986	768786	768775	27.8132	758315	758289	28.5208	751861	751840
25.1667	783499	783470	26.0313	775145	775119	26.7083	768697	768686	27.8854	757615	757586	28.5313	751762	751741
25.1771	783398	783369	26.0417	775046	775020	26.7188	768586	768575	27.8958	757496	757467	28.5417	751687	751666
25.2083	783125	783098	26.0521	774936	774910	26.8333	767444	767425	27.9063	757403	757374	28.5521	751586	751565
25.2188	783011	782985	26.0625	774846	774820	26.8438	767357	767337	27.9167	757305	757275	28.5736	751391	751370
25.2500	782722	782698	26.0729	774731	774704	26.8542	767247	767226	27.9271	757206	757176	28.5944	751201	751180
25.2604	782618	782594	26.0833	774644	774617	26.8646	767152	767130	27.9375	757106	757075	28.6042	751110	751090
25.2917	782336	782314	26.0938	774541	774514	26.8750	767024	767001	27.9479	757010	756979	28.6146	751009	750989
25.3021	782236	782215	26.1042	774440	774413	26.8854	766947	766924	27.9583	756904	756873	28.6250	750921	750901
25.3333	781929	781909	26.1146	774344	774317	26.8958	766847	766823	27.9688	756809	756777	28.6354	750826	750806
25.4063	781220	781203	26.1250	774260	774232	26.9063	766741	766717	27.9792	756708	756676	28.6563	750639	750620
25.4167	781119	781102	26.1354	774154	774126	26.9167	766646	766621	27.9896	756613	756581	28.6667	750549	750531
25.4271	781022	781006	26.1458	774078	774050	26.9271	766539	766514	28.0000	756523	756491	28.6771	750451	750433
25.4375	780922	780906	26.1563	773963	773934	26.9375	766440	766415	28.0104	756414	756382	28.6875	750362	750344
25.4479	780822	780807	26.1667	773855	773826	26.9590	766223	766197	28.0208	756329	756297	28.6979	750265	750247
25.4583	780723	780708	26.1778	773767	773738	26.9688	766142	766116	28.0313	756233	756201	29.4479	743372	743345
25.4688	780622	780607	26.1875	773689	773660	26.9792	766023	765997	28.0417	756144	756112	29.4583	743280	743254
25.4792	780532	780517	26.1979	773575	773546	26.9896	765930	765904	28.0521	756051	756019	29.4792	743085	743059
25.4896	780426	780411	26.2083	773464	773435	27.0000	765842	765815	28.0625	755954	755922	29.4896	743003	742978
25.5000	780324	780309	26.2188	773371	773342	27.0104	765749	765722	28.0729	755852	755820	29.5000	742915	742890
25.5104	780228	780214	26.2292	773260	773231	27.0208	765638	765610	28.0833	755755	755722	29.5792	742175	742150
25.5215	780131	780117	26.2396	773179	773150	27.0313	765542	765514	28.0938	755670	755637	29.5938	742037	742011
25.5313	780043	780029	26.2500	773059	773030	27.0417	765454	765425	28.1042	755588	755555	29.6042	741939	741913

$\hat{I}$	$\bar{F}$	r	$\hat{I}$	$\bar{F}$	r	$\hat{I}$	$\bar{F}$	r	$\hat{I}$	$\bar{F}$	r	$\hat{I}$	$\bar{F}$	r
29.6153	741844	741818	30.5833	732910	732882	33.3854	701105	701076	34.5313	689228	689200	35.5625	680491	680464
29.6257	741753	741727	30.5938	732803	732775	33.3958	700970	700941	34.5417	689138	689111	35.5729	680408	680381
29.6361	741658	741632	30.6042	732724	732696	33.4063	700867	700839	34.5521	689023	688996	35.5833	680317	680290
29.6465	741572	741546	30.6146	732631	732603	33.4167	700731	700703	34.5729	688837	688810	35.5938	680248	680222
29.6563	741474	741448	30.6250	732525	732496	33.4271	700613	700585	34.5833	688734	688707	35.6042	680156	680130
29.6771	741283	741257	30.6354	732439	732410	33.4375	700483	700455	34.5938	688631	688604	35.6146	680062	680036
29.6875	741181	741155	30.6979	731883	731854	33.4479	700375	700347	34.6042	688542	688515	35.6250	679995	679969
29.6979	741092	741066	30.7083	731789	731760	33.4583	700257	700229	34.6146	688452	688425	35.6354	679903	679877
29.7083	741012	740986	30.7188	731708	731679	33.4688	700125	700098	34.6250	688347	688320	35.6458	679819	679793
29.7326	740778	740752	30.7292	731615	731587	33.4792	700013	699986	34.6354	688262	688235	35.6563	679745	679719
29.7347	740760	740734	30.7396	731524	731496	33.4896	699875	699848	34.6458	688166	688139	35.6667	679660	679634
29.7396	740697	740671	30.7500	731428	731400	33.5000	699781	699754	34.6563	688059	688031	35.6771	679575	679549
29.7500	740608	740581	30.7604	731321	731293	33.5104	699639	699612	34.6667	687966	687938	35.6875	679473	679447
29.7604	740512	740485	30.7708	731238	731210	33.5208	699530	699503	34.6771	687881	687853	35.7083	679324	679297
29.7708	740418	740391	30.7813	731133	731105	33.5313	699391	699365	34.6875	687787	687759	35.7188	679223	679196
29.7813	740317	740290	30.7924	731038	731010	33.5417	699277	699251	34.6979	687693	687665	35.7396	679054	679026
29.7917	740223	740195	30.8333	730676	730649	33.5521	699163	699137	34.7083	687597	687568	35.7500	678981	678953
29.8021	740125	740097	30.8542	730484	730457	33.5625	699038	699012	34.7188	687510	687481	35.7604	678900	678872
29.8125	740024	739996	30.8646	730391	730364	33.5729	698931	698905	34.7292	687401	687371	35.7917	678642	678613
29.8229	739928	739900	30.8750	730294	730267	33.5938	698693	698667	34.7396	687334	687304	35.8021	678548	678519
29.8333	739840	739812	30.8854	730197	730170	33.6042	698563	698537	34.7500	687241	687211	35.8229	678400	678371
29.8542	739633	739604	30.9375	729712	729685	33.6146	698458	698432	34.7604	687141	687110	36.4063	673724	673693
29.8646	739535	739506	30.9479	729613	729586	33.6250	698333	698307	34.7708	687072	687041	36.5000	673015	672990
29.8750	739439	739410	31.0104	729019	728991	33.6354	698213	698186	34.7813	686974	686943	36.5104	672941	672917
29.8854	739331	739302	31.0313	728825	728797	33.6458	698082	698055	34.7917	686889	686857	36.5208	672858	672835
29.8958	739232	739203	31.0521	728624	728596	33.6563	697984	697957	34.8021	686788	686757	36.5313	672770	672748
29.9063	739141	739112	31.0625	728518	728491	33.6667	697851	697824	34.8229	686605	686573	36.5417	672695	672673
29.9167	739031	739002	31.0729	728423	728396	33.6771	697745	697718	34.8333	686528	686496	36.5521	672628	672607
29.9271	738934	738906	31.1250	727945	727920	33.6875	697633	697605	34.8438	686437	686406	36.5625	672541	672520
29.9375	738836	738807	31.1354	727854	727829	33.6979	697527	697499	34.8542	686352	686321	36.5729	672473	672453
29.9479	738719	738690	31.1563	727659	727634	33.7083	697400	697372	34.8646	686267	686236	36.5833	672373	672354
29.9583	738625	738596	31.1667	727568	727544	33.7188	697281	697252	34.8750	686168	686137	36.5938	672282	672263
29.9688	738532	738503	31.4278	725143	725121	33.7292	697161	697132	34.8854	686074	686043	36.6042	672201	672182
29.9792	738427	738398	31.4792	724617	724595	33.7500	696947	696917	34.8958	685985	685955	36.6146	672121	672102
29.9896	738327	738298	31.4896	724515	724493	33.7604	696831	696801	34.9063	685899	685869	36.6250	672044	672025
30.0000	738226	738197	31.5000	724414	724392	33.7708	696733	696702	34.9167	685825	685796	36.6458	671887	671868
30.0104	738127	738098	31.5104	724301	724279	33.7813	696618	696587	34.9271	685739	685710	36.6563	671804	671785
30.0208	738031	738002	31.5417	723994	723971	33.7917	696496	696465	34.9375	685634	685605	36.6667	671706	671687
30.0313	737928	737899	31.5521	723899	723876	33.8021	696373	696341	34.9479	685553	685524	36.6771	671637	671618
30.0417	737837	737808	31.5625	723785	723762	33.8125	696274	696242	34.9583	685455	685426	36.6875	671540	671520
30.0521	737741	737712	31.5833	723581	723559	33.8229	696170	696137	34.9688	685385	685356	36.6979	671476	671456
30.0625	737642	737613	31.6458	722973	722952	33.8333	696051	696018	34.9792	685296	685267	36.7083	671385	671365
30.0729	737544	737515	31.6667	722770	722749	33.8438	695947	695914	34.9896	685208	685179	36.7188	671293	671272
30.0833	737449	737420	31.6771	722652	722631	33.8542	695834	695801	35.0000	685125	685095	36.7292	671220	671199
30.0938	737356	737327	31.6875	722561	722540	33.8646	695722	695688	35.0104	685034	685004	36.7396	671128	671106
30.1042	737263	737234	31.6979	722468	722447	33.8750	695620	695586	35.0208	684957	684927	36.7500	671054	671032
30.1146	737165	737136	31.7708	721717	721695	33.8854	695514	695480	35.0313	684855	684825	36.7604	670965	670943
30.1250	737071	737041	31.7813	721627	721604	33.8958	695399	695365	35.0417	684767	684738	36.7708	670877	670854
30.1354	736979	736949	31.8125	721309	721286	33.9063	695286	695251	35.0521	684678	684648	36.7813	670802	670779
30.1458	736880	736850	31.8229	721211	721188	33.9167	695174	695140	35.0625	684578	684549	36.7917	670717	670693
30.1563	736786	736756	31.8333	721096	721073	33.9271	695076	695041	35.0729	684493	684464	36.8021	670640	670616
30.1667	736692	736662	31.8438	720973	720950	33.9375	694956	694921	35.0833	684402	684374	36.8125	670549	670525
30.1771	736594	736564	31.8646	720765	720742	33.9479	694859	694824	35.0938	684323	684295	36.8229	670479	670454
30.1875	736502	736472	31.8757	720649	720627	33.9583	694748	694713	35.1042	684231	684204	36.8333	670397	670372
30.1979	736409	736379	31.8958	720435	720413	33.9688	694641	694606	35.1146	684135	684109	36.8438	670320	670295
30.2083	736322	736292	31.9063	720311	720289	33.9792	694530	694495	35.1250	684054	684029	36.8646	670153	670127
30.2188	736228	736198	31.9271	720091	720069	33.9896	694419	694384	35.1354	683965	683940	36.8750	670081	670055
30.2292	736139	736109	31.9375	719970	719948	34.0000	694315	694279	35.1458	683866	683842	36.8854	670012	669986
30.2396	736037	736007	32.3854	714605	714590	34.0104	694209	694173	35.1563	683780	683757	36.8958	669927	669900
30.2500	735951	735921	32.3958	714472	714456	34.0208	694097	694061	35.1667	683693	683670	36.9063	669842	669815
30.2604	735838	735808	32.4063	714329	714313	34.0313	693979	693943	35.1771	683600	683578	36.9167	669760	669733
30.2708	735760	735731	32.4167	714195	714179	34.0417	693876	693840	35.1875	683522	683500	36.9271	669682	669655
30.2813	735657	735628	32.6563	710900	710880	34.0521	693780	693744	35.1979	683428	683406	36.9375	669617	669590
30.2917	735576	735547	32.7083	710170	710149	34.0625	693671	693635	35.2083	683325	683303	36.9479	669519	669492
30.3021	735477	735448	32.7292	709862	709841	34.0729	693563	693527	35.2188	683250	683228	36.9583	669468	669441
30.3125	735364	735336	32.7396	709717	709696	34.0833	693448	693412	35.2292	683164	683142	36.9792	669312	669284
30.3229	735267	735239	32.7500	709571	709550	34.0938	693326	693290	35.2396	683076	683053	36.9896	669236	669208
30.3333	735187	735159	32.7604	709423	709402	34.1042	693236	693200	35.2500	682976	682953	37.0000	669156	669128
30.3438	735088	735061	32.7708	709283	709262	34.1146	693129	693093	35.2604	682890	682866	37.0104	669076	669048
30.3542	735004	734977	32.7813	709125	709104	34.1354	692922	692886	35.2708	682810	682785	37.0208	668988	668960
30.3646	734910	734883	32.7917	708973	708952	34.1458	692811	692775	35.2813	682716	682691	37.0313	668907	668879
30.3750	734823	734796	32.8021	708830	708809	34.1667	692605	692569	35.3021	682542	682516	37.0417	668841	668813
30.3854	734722	734695	32.8125	708685	708664	34.3438	690935	690901	35.3542	682149	682121	37.0521	668757	668729
30.3958	734624	734597	32.8229	708530	708510	34.3542	690829	690796	35.3646	682055	682027	37.0625	668671	668643
30.4063	734529	734502	32.8333	708386	708366	34.3646	690725	690692	35.3750	681976	681948	37.0729	668589	668561
30.4167	734436	734409	32.8542	708081	708061	34.3750	690633	690600	35.3854	681906	681878	37.0833	668509	668481
30.4271	734331	734305	32.8646	707942	707922	34.3854	690531	690499	35.3958	681817	681788	37.0938	668433	668405
30.4375	734238	734212	32.8750	707792	707772	34.3958	690454	690422	35.4063	681732	681703	37.1042	668360	668332
30.4479	734136	734110	32.8854	707647	707627	34.4063	690358	690328	35.4167	681654	681625	37.1146	668274	668246
30.4583	734042	734016	32.8958	707503	707483	34.4167	690259	690228	35.4375	681491	681462	37.1250	668182	668154
30.4688	733963	733937	32.9063	707347	707326	34.4271	690163	690132	35.4479	681398	681369	37.1354	668116	668088
30.4792	733863	733837	32.9167	707210	707189	34.4375	690065	690034	35.4583	681320	681291	37.1458	668023	667995
30.4896	733762	733736	32.9271	707054	707033	34.4479	689968	689937	35.4792	681163	681134	37.1563	667949	667921
30.5000	733675	733649	33.1667	703781	703751	34.4583	689891	689861	35.4896	681080	681051	37.1667	667862	667834
30.5208	733472	733445	33.1875	703498	703468	34.4688	689791	689761	35.5000	680992	680963	37.1771	667776	667748
30.5313	733376	733349	33.1979	703358	703327	34.4792	689688	689659	35.5104	680918	680889	37.1875	667693	667666
30.5417	733281	733254	33.2813	702332	702301	34.4896	689590	689561	35.5208	680820	680791	37.1979	667616	667588
30.5521	733189	733162	33.3229	701823	701793	34.5000	689492	689463	35.5313	680740	680712	37.2083	667514	667487
30.5625	733100	733073	33.3646	701340	701311	34.5104	689397	689369	35.5417	680657	680629	37.2188	667437	667410
30.5729	732994	732966	33.3750	701232	701203	34.5208	689308	689280	35.5521	680573	680545	37.2292	667352	667325

$\hat{i}$	$\hat{F}$	r	$\hat{i}$	$\hat{F}$	r	$\hat{i}$	$\hat{F}$	r	$\hat{i}$	$\hat{F}$	r	$\hat{i}$	$\hat{F}$	r
37.2396	667254	667227	39.4896	646765	646764	40.8333	635419	635394	41.8750	626971	626936	43.4063	614637	614613
37.2500	667181	667154	39.5104	646596	646595	40.8438	635318	635293	41.8854	626881	626845	43.4167	614555	614531
37.2604	667076	667049	39.5313	646426	646425	40.8542	635234	635208	41.8958	626791	626755	43.4271	614457	614432
37.2708	666999	666973	39.5417	646345	646343	40.8750	635045	635018	41.9063	626697	626661	43.4375	614366	614341
37.2813	666909	666883	39.5938	645917	645913	40.8854	634956	634929	41.9167	626614	626577	43.4479	614281	614256
37.2917	666837	666811	39.6042	645809	645804	40.8958	634878	634850	41.9271	626541	626504	43.4583	614191	614166
37.3021	666742	666716	39.6146	645727	645722	40.9063	634787	634759	41.9375	626450	626413	43.4688	614116	614091
37.3125	666657	666631	39.6250	645658	645652	40.9167	634692	634663	41.9479	626367	626330	43.4792	614019	613994
37.3229	666580	666555	39.6354	645573	645567	40.9271	634594	634565	41.9583	626272	626235	43.4896	613941	613916
37.3333	666502	666477	39.6458	645470	645464	40.9375	634513	634484	41.9688	626173	626136	43.5000	613863	613839
37.3438	666418	666394	39.6563	645395	645389	40.9479	634424	634394	41.9792	626086	626049	43.5111	613768	613744
37.3542	666327	666303	39.6667	645294	645289	40.9583	634344	634314	41.9896	626013	625976	43.5208	613695	613671
37.3646	666243	666219	39.6771	645209	645204	40.9688	634261	634231	42.0000	625931	625894	43.5313	613594	613571
37.3854	666078	666055	39.6875	645124	645119	40.9792	634174	634143	42.0104	625843	625806	43.5417	613514	613491
37.4063	665913	665892	39.6979	645025	645020	40.9896	634088	634057	42.0208	625766	625729	43.5521	613421	613398
37.4271	665753	665733	39.7083	644932	644927	41.0000	634012	633980	42.0313	625686	625648	43.5625	613345	613322
37.4375	665668	665649	39.7188	644857	644852	41.0104	633921	633889	42.0417	625603	625565	43.5729	613265	613243
38.4896	655669	655667	39.7292	644749	644744	41.0208	633840	633808	42.0521	625521	625483	43.5833	613176	613154
38.5000	655587	655585	39.7396	644650	644645	41.0313	633761	633728	42.0625	625434	625396	43.5938	613096	613074
38.5104	655487	655485	39.7500	644569	644564	41.0417	633673	633640	42.0729	625354	625315	43.6042	613015	612994
38.5417	655205	655203	39.8958	643255	643244	41.0521	633599	633566	42.0833	625275	625236	43.6146	612934	612913
38.5625	655006	655004	39.9063	643166	643155	41.0625	633509	633475	42.0938	625203	625164	43.6250	612854	612833
38.5833	654820	654819	39.9167	643070	643058	41.0729	633444	633410	42.1042	625128	625089	43.6354	612794	612773
38.6042	654619	654618	39.9271	642982	642969	41.0833	633361	633327	42.3125	623525	623490	43.6458	612698	612677
38.6250	654416	654416	39.9375	642898	642885	41.0938	633280	633246	42.3229	623437	623403	43.6563	612627	612605
38.7813	652929	652930	39.9479	642793	642780	41.1042	633205	633171	42.3333	623339	623306	43.6667	612538	612516
38.7917	652833	652834	39.9583	642720	642706	41.1146	633114	633080	42.3438	623266	623234	43.6771	612474	612452
38.8021	652720	652720	39.9896	642454	642439	41.1250	633037	633003	42.3542	623170	623139	43.6875	612364	612342
38.8125	652620	652620	40.0104	642294	642278	41.1354	632961	632927	42.3646	623087	623056	43.6979	612292	612269
38.8229	652511	652510	40.0521	641956	641939	41.1458	632880	632846	42.3750	623005	622975	43.7083	612204	612181
38.8333	652434	652433	40.0625	641881	641864	41.1563	632796	632762	42.3854	622920	622891	43.7188	612116	612092
38.8438	652310	652308	40.0729	641789	641772	41.1667	632728	632694	42.3958	622833	622805	43.7292	612043	612019
38.8542	652229	652227	40.0833	641718	641700	41.1771	632641	632607	42.4063	622740	622713	43.7396	611959	611935
38.8646	652124	652121	40.0938	641633	641615	41.1875	632558	632524	42.4167	622651	622624	43.7500	611879	611854
38.8750	652043	652040	40.1042	641549	641531	41.1979	632480	632446	42.4271	622573	622547	43.7604	611794	611769
38.8958	651831	651827	40.1146	641472	641454	41.2083	632392	632357	42.4375	622486	622461	43.7708	611700	611674
38.9063	651737	651732	40.1250	641388	641369	41.2188	632317	632282	42.4479	622393	622368	43.7813	611635	611609
38.9167	651647	651641	40.1354	641306	641287	41.2292	632227	632192	42.4583	622301	622277	43.7917	611538	611512
38.9271	651572	651565	40.1458	641220	641201	41.2396	632145	632110	42.4688	622222	622198	43.8021	611452	611426
38.9375	651482	651475	40.1563	641145	641126	41.2500	632072	632037	42.4792	622127	622103	43.8125	611368	611341
38.9479	651393	651385	40.1667	641056	641037	41.2604	631982	631947	42.4896	622051	622028	43.8229	611276	611249
38.9583	651297	651288	40.1771	640973	640954	41.2708	631880	631845	42.5000	621971	621947	43.8333	611179	611152
38.9688	651227	651218	40.1875	640887	640868	41.2917	631719	631685	42.5104	621887	621864	43.8438	611083	611056
38.9792	651125	651115	40.1979	640806	640787	41.3229	631464	631431	42.5208	621810	621787	43.8542	611023	610996
38.9896	651042	651031	40.2083	640713	640694	41.3438	631278	631246	42.5313	621719	621696	43.8646	610911	610884
39.0000	650953	650942	40.2188	640635	640616	41.3542	631185	631153	42.5417	621640	621616	43.8750	610836	610809
39.0104	650853	650842	40.2396	640452	640433	41.3646	631105	631074	42.5521	621534	621510	43.8854	610740	610713
39.0208	650787	650775	40.2500	640362	640344	41.3750	631024	630993	42.5625	621464	621440	43.8958	610647	610620
39.0313	650695	650683	40.2604	640272	640254	41.3854	630920	630889	42.5729	621398	621374	43.9063	610556	610529
39.0417	650614	650602	40.2708	640189	640171	41.3958	630835	630805	42.5833	621311	621287	43.9167	610451	610424
39.0521	650529	650516	40.2917	640016	639999	41.4063	630746	630716	42.6042	621159	621135	43.9271	610350	610322
39.0625	650439	650426	40.3021	639919	639902	41.4271	630578	630549	42.6146	621074	621050	43.9375	610272	610244
39.0729	650350	650337	40.3125	639830	639813	41.4375	630481	630452	42.6250	620997	620973	43.9479	610185	610156
39.0833	650257	650243	40.3229	639747	639731	41.4479	630408	630379	42.6354	620909	620885	43.9583	610082	610053
39.0938	650180	650166	40.3333	639650	639634	41.4583	630317	630288	42.6458	620817	620793	43.9688	609999	609969
39.1042	650088	650074	40.3438	639555	639539	41.4688	630240	630211	42.6563	620746	620722	43.9792	609908	609878
39.1146	650000	649985	40.3542	639462	639446	41.4792	630153	630125	42.6667	620654	620630	43.9896	609808	609777
39.1250	649908	649893	40.3646	639357	639341	41.4896	630061	630033	42.6771	620581	620557	44.0000	609722	609690
39.1354	649825	649810	40.3750	639272	639256	41.5000	629991	629963	42.6875	620505	620481	44.0104	609640	609608
39.1458	649740	649724	40.3854	639197	639181	41.5104	629912	629884	42.6979	620411	620387	44.0208	609529	609497
39.1563	649651	649635	40.3958	639091	639075	41.5208	629827	629799	42.7083	620344	620321	44.0313	609445	609412
39.1667	649565	649549	40.4063	639007	638991	41.5313	629741	629714	42.7188	620266	620243	44.0417	609348	609315
39.1771	649473	649456	40.4271	638839	638823	41.5417	629657	629630	42.7292	620183	620160	44.0521	609266	609233
39.1875	649375	649358	40.4375	638752	638736	41.5521	629579	629552	42.7396	620091	620068	44.0729	609097	609063
39.1979	649278	649261	40.4479	638665	638649	41.5625	629517	629491	42.7500	620016	619993	44.0833	609009	608975
39.2083	649196	649179	40.4583	638574	638559	41.5729	629444	629418	42.7604	619926	619902	44.0938	608926	608891
39.2188	649092	649074	40.4792	638398	638383	41.5833	629363	629337	42.7708	619850	619826	44.1042	608841	608806
39.2292	648999	648981	40.5000	638229	638215	41.5938	629271	629246	42.7813	619751	619726	44.1146	608758	608723
39.2396	648896	648878	40.5208	638059	638046	41.6042	629182	629157	42.7917	619670	619645	44.1250	608678	608642
39.2604	648738	648721	40.5417	637898	637885	41.6250	629033	629009	42.8021	619588	619562	44.1354	608585	608549
39.2708	648634	648617	40.5833	637558	637546	41.6458	628861	628837	42.8125	619497	619470	44.1458	608495	608459
39.2813	648540	648523	40.6042	637378	637366	41.6563	628789	628766	42.8229	619386	619359	44.1563	608412	608376
39.2917	648438	648422	40.6250	637226	637214	41.6667	628701	628678	42.8333	619301	619273	44.1667	608338	608301
39.3021	648362	648346	40.6354	637135	637122	41.6771	628624	628601	42.8438	619220	619192	44.1771	608252	608215
39.3125	648262	648247	40.6458	637050	637037	41.6875	628526	628503	42.8542	619141	619112	44.1875	608164	608127
39.3229	648181	648166	40.6563	636974	636961	41.6979	628466	628443	42.8646	619033	619004	44.1979	608080	608043
39.3333	648084	648070	40.6667	636884	636870	41.7083	628367	628343	42.8750	618944	618915	44.2083	607998	607962
39.3438	647987	647974	40.6771	636805	636791	41.7188	628277	628253	42.8854	618863	618833	44.2188	607928	607892
39.3542	647892	647880	40.6875	636716	636701	41.7292	628205	628181	42.8958	618767	618738	44.2292	607842	607806
39.3646	647793	647782	40.7083	636530	636514	41.7396	628122	628097	42.9063	618674	618645	44.2396	607751	607716
39.3750	647698	647688	40.7188	636424	636407	41.7500	628020	627995	42.9167	618599	618570	44.2500	607674	607639
39.3854	647626	647617	40.7396	636244	636225	41.7604	627939	627913	42.9271	618503	618474	44.2604	607587	607553
39.3958	647543	647535	40.7500	636152	636132	41.7813	627759	627732	42.9375	618411	618382	44.2708	607509	607476
39.4063	647458	647451	40.7604	636068	636047	41.7917	627682	627654	42.9479	618324	618295	44.2813	607414	607382
39.4167	647363	647357	40.7708	635971	635949	41.8021	627586	627557	42.9583	618225	618197	44.2917	607327	607295
39.4271	647278	647273	40.7813	635878	635856	41.8125	627491	627461	42.9688	618146	618118	44.3021	607243	607212
39.4479	647114	647111	40.7917	635779	635756	41.8229	627404	627373	42.9896	617961	617933	44.3125	607157	607128
39.4583	647004	647002	40.8021	635696	635673	41.8333	627309	627277	43.3750	614920	614896	44.3229	607070	607042
39.4688	646922	646921	40.8125	635610	635586	41.8542	627138	627104	43.3854	614816	614792	44.3333	606975	606948
39.4792	646842	646841	40.8229	635509	635485	41.8646	627062	627028	43.3958	614733	614709	44.3438	606897	606871

$\hat{t}$	$\hat{F}$	r	$\hat{t}$	$\hat{F}$	r	$\hat{t}$	$\hat{F}$	r	$\hat{t}$	$\hat{F}$	r	$\hat{t}$	$\hat{F}$	r
44.3542	606818	606793	45.3021	598691	598660	46.2604	590203	590163	47.2604	581489	581463	48.5417	570256	570235
44.3646	606724	606700	45.3125	598605	598574	46.2708	590103	590063	47.2708	581403	581376	48.5521	570163	570143
44.3750	606644	606620	45.3229	598525	598495	46.2813	590015	589975	47.2813	581318	581291	48.5625	570075	570055
44.3854	606551	606528	45.3340	598422	598392	46.2917	589923	589884	47.2917	581237	581211	48.5729	569987	569968
44.3958	606466	606444	45.3438	598338	598308	46.3021	589840	589802	47.3021	581146	581120	48.5833	569888	569869
44.4063	606372	606350	45.3542	598266	598237	46.3125	589745	589707	47.3125	581073	581047	48.5938	569793	569775
44.4167	606279	606258	45.3646	598177	598148	46.3229	589648	589611	47.3229	580974	580948	48.6042	569714	569697
44.4271	606182	606161	45.3750	598078	598049	46.3333	589568	589531	47.3333	580889	580864	48.6146	569608	569591
44.4375	606094	606074	45.3854	597991	597963	46.3438	589469	589433	47.3438	580798	580774	48.6250	569536	569519
44.4479	606013	605993	45.3958	597898	597870	46.3542	589389	589353	47.3542	580721	580697	48.6354	569430	569413
44.4583	605906	605887	45.4063	597819	597791	46.3646	589303	589268	47.3646	580642	580619	48.6458	569337	569320
44.4688	605820	605801	45.4167	597712	597684	46.3750	589206	589171	47.3750	580553	580531	48.6563	569252	569236
44.4792	605737	605719	45.4271	597620	597593	46.3854	589112	589078	47.3854	580468	580447	48.6667	569151	569135
44.4896	605648	605630	45.4375	597537	597510	46.3958	589032	588998	47.3958	580382	580361	48.6771	569047	569031
44.5000	605551	605533	45.4583	597347	597320	46.4063	588918	588885	47.4063	580275	580255	48.6875	568945	568928
44.5104	605474	605457	45.4688	597259	597232	46.4167	588851	588818	47.4167	580202	580182	48.6979	568861	568844
44.5208	605384	605367	45.4792	597175	597148	46.4271	588748	588715	47.4479	579935	579916	48.7097	568764	568747
44.5313	605294	605278	45.4896	597075	597048	46.4375	588654	588621	47.4583	579863	579845	48.7188	568661	568643
44.5424	605197	605181	45.5000	596998	596969	46.4479	588559	588527	47.4688	579752	579734	48.7292	568574	568556
44.5521	605109	605093	45.5104	596905	596878	46.4583	588469	588437	47.4792	579669	579652	48.7500	568396	568377
44.5625	605032	605017	45.5208	596835	596808	46.4688	588381	588349	47.4896	579572	579555	48.7604	568295	568276
44.5729	604945	604931	45.5313	596712	596685	46.4792	588299	588267	47.5104	579407	579390	48.7708	568194	568175
44.5833	604858	604844	45.5417	596623	596596	46.4896	588208	588176	47.5208	579322	579306	48.7917	568000	567980
44.5938	604760	604746	45.5521	596538	596512	46.5000	588113	588082	47.5313	579220	579204	48.8021	567928	567907
44.6042	604667	604654	45.5625	596441	596415	46.5104	588015	587984	47.5417	579121	579105	48.8125	567833	567812
44.6146	604589	604576	45.5729	596329	596303	46.5208	587938	587907	47.5521	579045	579029	48.8229	567726	567705
44.6250	604515	604502	45.5833	596271	596245	46.5313	587849	587818	47.6146	578474	578457	48.8333	567633	567612
44.6354	604434	604421	45.5944	596160	596134	46.5417	587749	587718	47.6250	578385	578368	48.8438	567557	567535
44.6458	604324	604311	45.6049	596082	596057	46.5521	587646	587615	47.6354	578289	578271	48.8542	567468	567446
44.6563	604238	604225	45.6146	596002	595977	46.5625	587548	587518	47.6458	578214	578196	48.8646	567368	567345
44.6667	604173	604159	45.6250	595914	595889	46.5729	587478	587447	47.6563	578117	578098	48.8750	567286	567263
44.6771	604086	604072	45.6354	595827	595802	46.5833	587372	587342	47.6667	578027	578008	48.8854	567191	567168
44.6875	603996	603981	45.6458	595744	595720	46.5938	587298	587268	47.6771	577929	577910	48.8958	567097	567074
44.6979	603908	603893	45.6563	595646	595622	46.6042	587205	587175	47.6875	577839	577819	48.9063	567012	566989
44.7083	603823	603807	45.6667	595557	595533	46.6250	587004	586974	47.6979	577747	577727	48.9167	566921	566897
44.7188	603737	603720	45.6771	595473	595449	46.6354	586931	586901	47.7083	577651	577630	48.9271	566829	566805
44.7292	603652	603634	45.6875	595363	595340	46.6458	586837	586807	47.7188	577541	577520	48.9375	566739	566715
44.7396	603559	603540	45.6979	595284	595260	46.6563	586743	586713	47.7292	577467	577446	48.9479	566644	566620
44.7500	603464	603444	45.7083	595208	595184	46.6667	586656	586626	47.7396	577381	577359	48.9583	566548	566524
44.7604	603385	603363	45.7188	595097	595073	46.6771	586560	586530	47.7813	576997	576974	48.9688	566465	566441
44.7708	603307	603284	45.7292	595011	594987	46.6875	586463	586433	47.7917	576910	576886	48.9792	566365	566341
44.7813	603215	603191	45.7396	594923	594898	46.6979	586386	586355	47.8021	576820	576796	48.9896	566272	566247
44.7917	603119	603093	45.7507	594828	594802	46.7083	586279	586249	47.8125	576719	576695	49.0000	566180	566155
44.8021	603022	602996	45.7708	594645	594617	46.7188	586191	586160	47.8229	576638	576614	49.0104	566093	566068
44.8125	602946	602919	45.7813	594562	594533	46.7396	586019	585988	47.8333	576559	576535	49.0208	566005	565979
44.8229	602851	602823	45.7917	594460	594430	46.7500	585938	585907	47.8438	576450	576426	49.0313	565896	565870
44.8333	602763	602735	45.8021	594371	594341	46.7604	585848	585817	47.8542	576352	576328	49.0417	565801	565775
44.8542	602562	602533	45.8125	594293	594261	46.7708	585752	585721	47.8646	576279	576255	49.0521	565704	565678
44.8646	602482	602453	45.8229	594201	594169	46.7813	585661	585630	47.8750	576180	576156	49.0625	565615	565588
44.8750	602392	602363	45.8333	594118	594085	46.7917	585572	585542	47.8854	576087	576063	49.0729	565522	565495
44.8854	602307	602278	45.8438	594019	593986	46.8021	585489	585459	47.8958	575994	575970	49.0833	565422	565395
44.8958	602198	602169	45.8542	593922	593888	46.8125	585406	585376	47.9063	575906	575882	49.0938	565336	565309
44.9063	602111	602083	45.8646	593833	593799	46.8229	585317	585287	47.9167	575804	575780	49.1042	565227	565199
44.9167	602006	601978	45.8750	593747	593713	46.8333	585211	585182	47.9271	575719	575695	49.1146	565133	565105
44.9271	601917	601889	45.8854	593643	593609	46.8438	585130	585101	47.9375	575624	575600	49.1250	565048	565020
44.9375	601819	601791	45.8958	593550	593516	46.8542	585024	584995	47.9479	575531	575507	49.1354	564963	564935
44.9479	601728	601700	45.9063	593454	593420	46.8750	584862	584833	47.9583	575437	575413	49.1458	564851	564822
44.9583	601639	601611	45.9167	593371	593337	46.8854	584799	584770	47.9688	575350	575325	49.1563	564757	564729
44.9688	601554	601526	45.9271	593273	593239	46.8958	584689	584660	47.9792	575254	575229	49.1667	564652	564623
44.9792	601447	601419	45.9375	593179	593145	46.9375	584335	584306	47.9896	575154	575129	49.1771	564559	564530
44.9896	601357	601329	45.9479	593075	593040	46.9479	584247	584218	48.0000	575070	575044	49.1875	564463	564434
45.0000	601265	601237	45.9583	592983	592948	46.9583	584149	584120	48.0104	574965	574939	49.1979	564362	564333
45.0104	601172	601144	45.9688	592887	592852	46.9688	584058	584030	48.0208	574879	574852	49.2083	564278	564250
45.0208	601076	601047	45.9792	592782	592747	46.9792	583972	583944	48.0313	574789	574762	49.2188	564177	564149
45.0313	600981	600952	45.9896	592686	592650	46.9896	583876	583848	48.0417	574670	574643	49.2292	564097	564069
45.0424	600872	600843	46.0000	592589	592553	47.0000	583791	583763	48.0521	574580	574552	49.2500	563913	563886
45.0521	600794	600765	46.0104	592484	592448	47.0104	583690	583663	48.0729	574394	574366	49.2604	563816	563790
45.0625	600701	600671	46.0208	592392	592356	47.0208	583597	583571	48.2917	572404	572377	49.2708	563719	563693
45.0729	600607	600577	46.0313	592291	592255	47.0313	583501	583475	48.3021	572322	572295	49.2813	563621	563596
45.0833	600519	600489	46.0417	592198	592161	47.0417	583405	583380	48.3125	572224	572197	49.2917	563525	563500
45.0938	600426	600396	46.0521	592090	592053	47.0521	583309	583284	48.3229	572134	572107	49.3021	563433	563409
45.1042	600344	600314	46.0625	592002	591965	47.0625	583215	583191	48.3438	571970	571943	49.3125	563355	563332
45.1146	600245	600215	46.0729	591898	591861	47.0736	583126	583103	48.3542	571864	571837	49.3229	563264	563241
45.1250	600152	600122	46.0833	591796	591759	47.0833	583034	583011	48.3646	571783	571756	49.3333	563183	563161
45.1354	600064	600034	46.0938	591709	591671	47.0938	582950	582927	48.3750	571695	571669	49.3438	563108	563086
45.1458	599976	599946	46.1042	591616	591578	47.1042	582834	582812	48.3854	571614	571588	49.3542	562995	562973
45.1563	599895	599864	46.1146	591515	591477	47.1146	582755	582733	48.3958	571528	571502	49.3646	562915	562894
45.1667	599806	599775	46.1250	591418	591379	47.1250	582658	582636	48.4063	571437	571411	49.3750	562825	562803
45.1771	599720	599689	46.1354	591319	591280	47.1354	582561	582539	48.4167	571340	571314	49.3854	562737	562716
45.1875	599633	599602	46.1458	591223	591184	47.1458	582478	582456	48.4271	571264	571238	49.3958	562643	562622
45.1979	599552	599521	46.1563	591129	591089	47.1563	582391	582368	48.4375	571177	571152	49.4063	562560	562539
45.2083	599460	599429	46.1667	591044	591004	47.1667	582305	582282	48.4479	571069	571044	49.4167	562456	562435
45.2188	599370	599339	46.1771	590940	590900	47.1771	582210	582186	48.4583	570983	570958	49.4271	562408	562386
45.2292	599290	599259	46.1875	590846	590806	47.1875	582126	582102	48.4688	570894	570870	49.4375	562320	562299
45.2396	599204	599173	46.1979	590755	590715	47.1979	582031	582006	48.4792	570813	570789	49.4479	562228	562207
45.2500	599137	599105	46.2083	590658	590617	47.2083	581941	581916	48.4896	570712	570689	49.4583	562133	562112
45.2604	599037	599006	46.2188	590563	590522	47.2188	581844	581818	48.5000	570626	570603	49.4688	562043	562022
45.2708	598947	598916	46.2292	590476	590436	47.2292	581755	581729	48.5104	570517	570495	49.4792	561963	561942
45.2813	598856	598824	46.2396	590388	590347	47.2396	581673	581647	48.5208	570450	570428	49.4896	561875	561854
45.2917	598774	598743	46.2500	590294	590253	47.2500	581581	581555	48.5313	570356	570335	49.5007	561775	561754

*GPO 579 - 026 (1985)